

The Chemical Age

Weekly Journal Devoted to Industrial and Engineering Chemistry

Vol. L
1297

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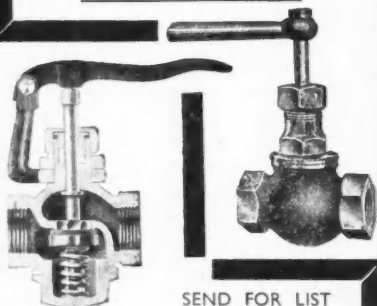
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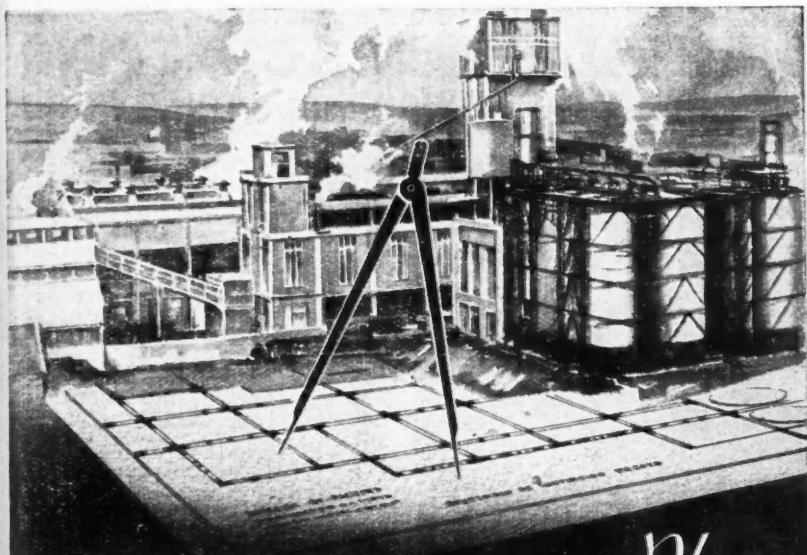
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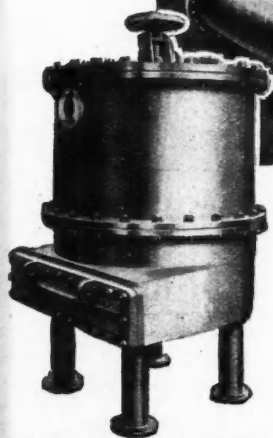
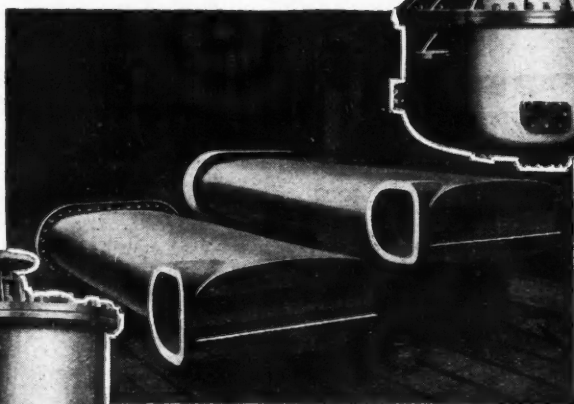
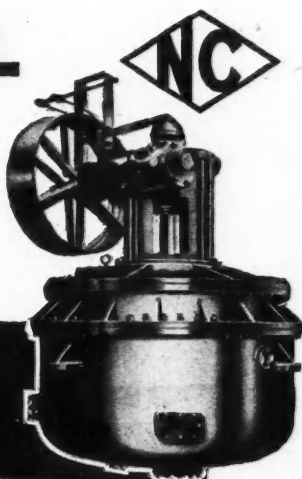
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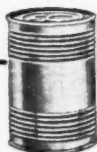
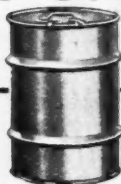
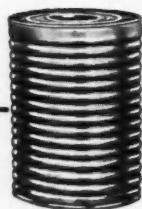
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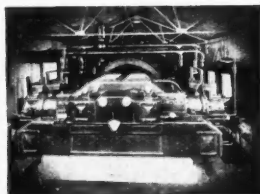
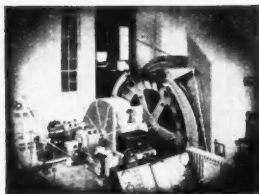
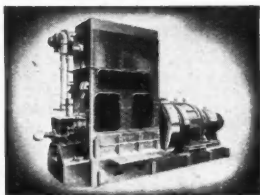
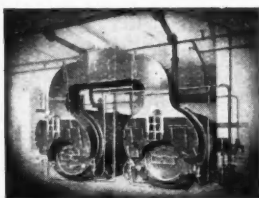
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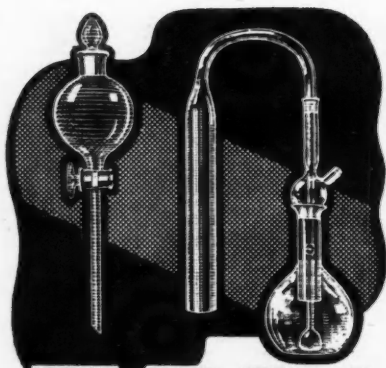
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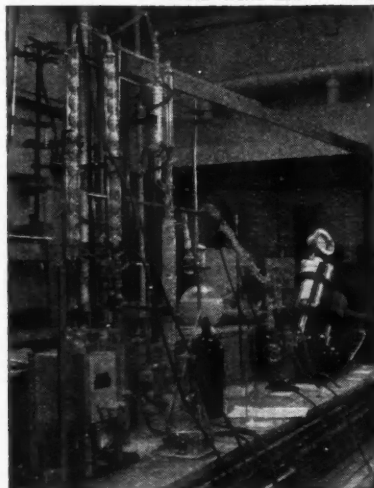
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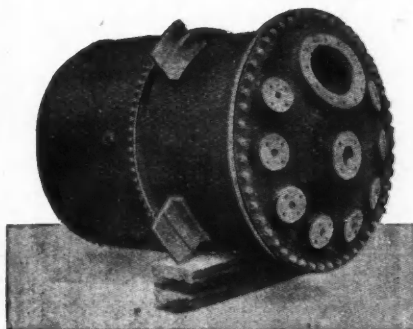
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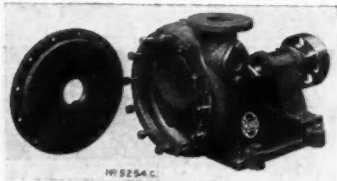
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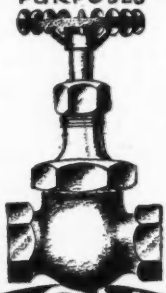
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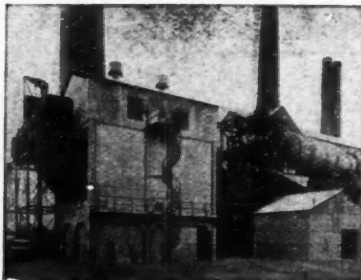
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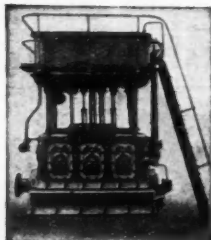
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Hours of Work

IT has been announced in the daily Press that the General Council of the Trades Union Congress proposes to make a 40-hour working week, without reduction of wage rates, a principal aim of its after-war policy, and to ask the Government to introduce an enabling Bill to empower industries by agreement between the organised employers and workpeople to establish the shorter week, which would then be obligatory on all undertakings in the industry. It is suggested also that in certain cases, where joint negotiating machinery is inadequate, the initiative should rest elsewhere. Before proceeding to suggest the lines of the proposed legislation the General Council has decided to call for the considered views of the Unions on the method of applying the shorter week in their particular industries.

This proposal will be received by the country in general with mixed feelings, and it is well to consider some of the implications of the demand. The T.U.C. has long passed beyond the stage of irresponsibility. It employs economists and technical men of high qualifications, and its members for the most part realise that there is a limit to the demands of labour. We are all in the same boat in that we must secure the maximum

productive work, including a very much larger quantity of exports, if there are to be any wages at all. We have gone beyond the state of affairs of 100 years ago, when men who were without work might starve in the gutter with no hand raised to help them, and we have arranged to pay unemployment allowance to those who cannot work. But there is no one to pay unemployment allowance to us as a nation, and if the proposal should happen to affect our ability to compete in the post-war world it would be disastrous if it were to be pressed. We believe that the T.U.C. is fully alive to such dangers, and the new employers' trade associations that have arisen during the war will in any event be able to put this view forward powerfully, with facts and figures to back it up.

The hours worked per week have been

easing steadily over a long period, and so have the conditions of labour. It is an old story, but worth while reminding ourselves of the conditions of 100 years ago. A witness at one of the Royal Commissions in 1832 spoke of a West India slave master who told the spinners of Bradford: "I have always thought myself disgraced by being the owner of black slaves, but we never, in the West Indies, thought it was possible for any human being to re-

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quire a child of nine years old to work 12½ hours a day; and that, you acknowledge, is your regular practice." About the same time Richard Oastler started an agitation to improve the lot of the workers, and the Yorkshire and Lancashire mill-owners proposed to employ no child under nine, and to limit the mill hours to 11½ including 1½ hours for meals, and to 8½ hours on Saturday, giving a 66-hour week. It seemed that all was to be well, but in 1831 the mill-owners of Halifax, perhaps the worst town for sweated labour, held a meeting, and proposed to send a petition to Parliament for a 72-hour week. Oastler attacked the arguments of these men, but they had started the opposition from the manufacturers and this increased. The Bill was whittled down to a 69-hour week for children in cotton factories only.

Since that time the whole conditions of employment have improved, in that wages have increased, and consequently the standard of living has improved, while working hours have gone down. Broadly speaking, it can now be considered that eight hours a day is a normal peace-time working shift, though it is not infrequent for it to be somewhat longer, and many office workers work up to ten hours, including mealtimes. There are industries working eight hours a day from Monday to Friday, with four or five hours on Saturday, and having Saturday afternoon and Sunday off. There are other industries that work seven days a week, again generally in eight-hour shifts, making a fifty-six hour week. Probably very few people work longer than this unless by way of overtime, which they gladly do because it means extra pay. We should expect the five-day week to become the general practice. Taking the whole history of the last century into account, the proposal for a 40-hour maximum week is in keeping with the trends of employment and should, on the surface, assist in promoting employment by spreading the available work. The raising of the school age will be another advantage, in that it will take away the whole age groups of 14 and 15 from industry.

On the other hand, the economic side of the proposal must not be forgotten, because it will be noted that the T.U.C. is demanding that there shall be no reduction in wage rates. Just what is

meant by wage rates must be defined. If it means pay per hour, one imagines that many of the workers will not be very happy about the proposal because a few shillings a week makes a considerable difference to the family budget. If, on the other hand, as we suspect, it means that the total earnings of the employee shall remain the same, so that the wage rate per hour is increased, the proposal will obviously have to be looked at very carefully, and we welcome the call for the considered views of the Unions on the method of applying the shorter week in their particular industries. If a concern is working seven days a week, as in coke ovens and in gas works, it would mean a six-hour working day which would actually give 42 hours a week. The problem which the employer has to solve is whether the labour cost per unit of product will be increased so greatly that he will be handicapped in selling. If prices advance, people buy less in this country, because they economise in their consumption. Under the same conditions the foreigner may not buy from us at all, as he may find a cheaper market.

This subject was dealt with in THE CHEMICAL AGE of March 25 in an article on National Productivity, and it was there shown that we in this country already manufactured before the war a smaller quantity of goods per man-hour than our greatest trade rivals, and that our wages costs were the highest of the three great industrial exporting nations, Britain, U.S.A., and Germany. These facts will profoundly affect our competitive power in the post-war export market, and we suggest that the problem of re-equipping industry must be studied from this angle of relative costs. In other words, we must increase our productivity per man if we are to meet increased labour costs due to a reduction in the working hours. Whether this will not equally lead to less employment because of this greater productivity is a matter which we suggest the T.U.C. and the employers' associations should consider very carefully. We trust that this proposal will not be put forward as a political plank based upon party politics, but that it will be considered dispassionately in order to determine what may be best for the welfare of industry and of the individual, whose welfare depends on that of the industry in which he works.

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NOTES AND COMMENTS

Small Mercies

THE Budget is a case of being thankful for small mercies. It is, admittedly, a relief to know that there is to be no increase of taxation of any kind during the present financial year. The taxpayer, however, cannot help being disappointed at not being handed a consolation prize in a promise of some relief when the worst phase of the present emergency is passed. Sir John Anderson was at pains to make it clear that there was little chance of an easing of burdens without precedent in British history as soon as the German menace was removed. Instead, he dwelt on some of what he called the sombre facts of the present situation, more particularly the loss of overseas investments and the transformation of this country from a creditor to a debtor nation. He gave a salutary warning, too, about the danger of inflation caused by the growing demand for higher wages and salaries. On the other side of the picture he put a gratifying increase in the contribution made by the personal saver, and he opened up a prospect of income-tax allowances for industrial re-equipment and rebuilding after the war. This promise will give some satisfaction to the large manufacturer, but the small man and industry's indispensable ally, the merchant, must feel that now as before they are being left out in the cold. It is true that Sir John Anderson made a small E.P.T. concession in raising the standard by £1000, but this will affect only isolated cases among the half-million small firms which still manage to keep their heads above water. He positively refused to touch the major grievance represented by a stark 100 per cent. rate of tax.

Political Considerations

INDEED, he was so frank as to say that the 100 per cent. rate sprang from other considerations than those of a purely fiscal policy, and that these other considerations remain to-day in full force. These considerations can only have a political flavour, and it is a sinister outcome of the present grouping of parties that national finance should have been twisted in any degree to other

than fiscal ends. The taxpayer apparently will have to go on bearing these and other burdens with such fortitude as he can summon to his aid until the end of the chapter. Individually and collectively, the taxpaying class has nothing to reproach itself with. It is shouldering well over 50 per cent. of the national expenditure, a far higher proportion than that borne by any former war generation, or by any other belligerent nation at the present time. Sir John Anderson is entitled to all credit for painting the dark parts of his picture, for the sooner the public mind is disabused of the idea that the nation is going to be richer after the war, the more hopeful will be the prospect of its working harder at the stern task of making ends meet in what for a long time must be a poorer world for all.

Filming Penicillin Progress

LAST Christmas we published a note in which we advocated that a film about penicillin should be made. We commented that such a film would have a vivid and popular appeal. I.C.I. must have taken the same view, for we are informed that this company is sponsoring, in conjunction with the Therapeutic Research Corporation, a penicillin film. In all probability the film, when completed, will be distributed by the Ministry of Information and that, coupled with the fact that the film will be designed to appeal to non-specialist audiences, should ensure a wide showing. We should like to see it screened in as many ordinary cinemas as possible, for then it could do a great deal towards removing the popular misconceptions that exist about this "miracle drug." The original work on this drug took place in this country, and the film when shown abroad should help to establish, or where necessary restore, the indisputable British claim for priority of discovery and initial development for therapeutic purposes. Mr. Alexander Shaw, the well-known documentary director, will be making this picture, and in writing the script he will enjoy the collaboration of Professor Fleming, Professor Florey, and Dr. Chain.

The Patent System

THE Council of the Chartered Institute of Patent Agents has just published a report on the British Patent system. We bring it to our readers' attention, not because it is a particularly informative or forward-looking document, but merely because the subject of patent reform is in the air at the moment. The Government has set up a commission to investigate the operation of the existing patent laws, and the very fact that the Government has set up such a body seems to be an indication that some sort of reform is needed. The Patent Agents' report concludes "... the existing system of fostering invention by the granting of effective monopolies, with adequate safeguard against abuse, seems the most practicable." Such a comment seems to us to beg the whole question. If those words can be claimed to describe accurately the present code of patent law, then there would be no need for the Government to take the step it has.

Fuel from Waste

INGENIOUS methods for saving fuel are of highest importance to-day, and our contemporary, *Fuel Efficiency News*, is to be congratulated on collecting some extremely interesting examples of the use of waste for fuel, which are noted hereunder. It is pointed out that many of these waste materials can be used as fuel, either alone or mixed with coal or coke. Frequently the waste is bulky for its weight and will not pay for transport, but it can be used to good purpose close to the point of production. (i) *Coal from Pyrites*: Plants now in operation recover pyrites from colliery waste at the rate of 25,000 to 30,000 tons annually. At the same time as pyrites is extracted, approximately twice as much coal is also recovered. These plants, therefore, represent a miniature coal mine turning out about 1000 tons per week. (ii) *Cellulose Material from Flax*: In flax mills, unspinnable cellulose material which has a fairly high calorific value is removed from the fibre in the preparing process. The material is about seven times as bulky as coal, and if hand-fired it involves a high expenditure of labour. A simple arrangement of blower and hopper for mechanical feeding has, however, been suggested. (iii) *Waste*

Liquids from Paper Mills: Mills producing pulp from straw, etc., often recover the caustic soda employed. At a certain stage of the recovery process a combustible oil is produced, and some mills have been equipped to burn this. (iv) *Wood Chips*: One firm has reduced its coal consumption for the present year to 27 tons, as against 64 tons the previous year, by burning wood chips. (v) *Spent Tan*: This material can often be used when banking fires, and gives good results in firing when mixed with coal in proper proportions. (vi) *Sawdust*: By burning sawdust from a neighbouring mill, a tannery in Wiltshire has reduced its coal consumption to half. With such examples in mind, it should not be beyond the ingenuity of industrial chemists to contrive parallel devices to suit their own particular plant.

TVA Chemical Products

Lack of Phosphate Fertilisers

THE electrochemical industries associated with the great hydroelectric plants of the Tennessee Valley Authority are making a substantial contribution to the Allied war effort. According to the annual report of the Authority, output of electric power amounts to 9000 million kWh, and three-quarters of this is used for war purposes. The TVA fertiliser plant at Muscle Shoals, modernised during this war, is turning out large quantities of ammonia and ammonium nitrate for explosives, elementary phosphorus for incendiary bombs and smoke screens, and carbide for synthetic rubber; 13,600 tons of ammonium nitrate for agricultural use were released on the curtailment of the allocation of this substance to explosives manufacture.

Of 77,300 tons of concentrated superphosphate shipped from the Muscle Shoals plant, 54,000 tons were provided for Lend-Lease; 60,200 tons of concentrated superphosphate were produced there during the year ended June 30, 1943, as well as 7300 tons of calcium metaphosphate containing 65 per cent. P_2O_5 . During the current year TVA plans to produce 15,000 tons of dicalcium phosphate, which will be used to replace bone meal in farm animal feeds. TVA fertilisers containing the optimum amount of phosphorus have been found to increase by 30 per cent. the crop yields obtained on experimental farms, and the present capacity for making phosphatic fertilisers in the U.S. (1,712,000 tons a year) will have to be doubled to bring all the nation's farms to a comparable level.

Chemicals and Metals of Yugoslavia

A Survey of the Industrial Potential

(From a Special Correspondent)

ALTHOUGH literature about economic conditions in Yugoslavia is practically confined to a publication of the Belgrade Institute for the Promotion of Export, entitled *The Economy of Yugoslavia*, 1937, various sources can be adduced in an assessment of the industrial situation of the country. The situation may have changed since the occupation, but only a little, because the Nazis, in face of the brave resistance of the Yugoslav patriots, have been unable to subjugate the country and have not succeeded in getting as strong a grip on its resources and its industry as they have elsewhere. Therefore, there are some hopes that after the war Yugoslavia will find her economic existence partially intact and that she will, with her well-attested diligence and perseverance, be able to resume the development of her industrial life.

Yugoslavia, with about 14 million inhabitants, is a preponderantly agricultural country, but is very rich in industrial plants, e.g., sugar beet, tobacco, hops, poppy seed, red pepper, aniseed, and chicory. Oil-bearing plants include olives, linseed and rape seed, sunflower, sesame, soya bean, and castor oil. Fibre-producing vegetation comprises not only hemp, flax, and cotton, but also the huge forests which can serve as raw material for cellulose. A speciality is the production of pyrethrum, for which a research institute, supported by American scientists, existed at Split, and of which about 500 tons were exported yearly.

Unexploited Wealth

Mining and metallurgy are the most vital branches of Yugoslavian industry, and although they are not yet developed in proportion to the abundant possibilities, few countries in the world dispose of so manifold a wealth of treasures as does Yugoslavia. Deposits exist of coal, iron, copper, lead, zinc, chromium, manganese, asphalt, bauxite, gypsum, magnesite, and barytes, and even the rarer minerals, such as antimony, gold, and silver, are known to exist. Most of the deposits have not yet been exploited, or even sufficiently explored, owing to lack of capital. The development of the mining industry since the last war shows, after a rapid rise to a peak in 1929, a decline during the years of the economic crisis, until in 1934 it dropped to 65 per cent. of its 1929 level. With the general financial improvement in 1935, the opening of many new mines, and the opening up and enlargement of deposits previously worked, betokened a restoration of mining activity. The number of mines at work before the present war was 155, of which nine

produced coal, 59 brown coal, 48 lignite, seven iron ore, three lead and zinc ores, including also pyrites, one copper ore, four antimony ore, eight chromium ore, one manganese ore, two pyrites, seven bauxite, five magnesite, and one gold-bearing quartz. To these must be added plants for the exploitation of alluvial gold, of mineral oil and natural gas, of brine, asphalt, barytes, gypsum, clay, and marl. To-day it is possible that nine smelting works may be working, three of which produce iron, two raw lead, one each raw zinc and raw copper, and two antimony.

Copper Deposits

Of first importance in the Yugoslavian mining industry is the copper ore, Yugoslavia taking, after Russia, the second place in Europe. The richest deposits are in the north-east of the Morava Banat, in the commune of Bor. The ores consist mainly of pyrites, covellite, and enargite, and contain on an average between 3 and 6 per cent. copper and a maximum of 4 gm. gold per ton. Superimposed on the main deposits is a quartz hood—a characteristic sign of these copper deposits—which led to their discovery in 1912. The mines were opened and worked by the French company, Mines de Bor, with a capital of 5½ million francs, which up to 1935 had invested more than 50 million francs in the mine, and which met with such success that in the year before the outbreak of the present war a dividend of 120 per cent. was paid out.

After sorting, the Bor copper ores are treated by flotation. The smelting of the ores and concentrates is carried out in blast-furnaces and converters. The flotation agent is an ethyl-xanthate/pine-oil mixture. The ores are next either briquetted or sintered in a Dwight-Lloyd apparatus, and afterwards blasted in a water-jacket furnace to black copper of 30-40 per cent. copper content. The black copper is refined in converters to raw copper of 99.3-99.5 per cent. purity. In 1935, 649,000 tons of ore and 39,000 tons of raw copper were produced. The raw copper was originally sent for electrolytic treatment to the North German Refinery in Hamburg, but in 1937, by Government order, the Mines de Bor company erected an electrolytic refinery with an annual capacity of 30,000 tons, in connection with which 3.5 to 4 tons of gold are extracted per annum. The waste waters from the mines contain 25 gm. copper per litre and yield about 250 tons of cement copper annually.

Important deposits of galena and zinc-blende, which always appear in Yugoslavia

as complex ores, are found in many districts. By far the greatest production is in the Trepcia mine in the south-eastern part of the Zeta Banat, to which over 80 per cent. of the total production is attributable. This mine belongs to a British company, Trepcia Mines, Ltd., which possesses a fully up-to-date plant, the works being largely electrified. The ores contain an average of 9 per cent. lead and 8 per cent. zinc, and assay 3 oz. silver per ton of raw ore. The total deposit has been estimated at about 3,000,000 tons. Chromium also is of great importance, ores with a 35-50 per cent. metal content being found in various parts of the country. In the deposits near Gradac, ores assaying as much as 56 per cent. have been ascertained. The concentrates went mostly to Germany.

Pyrites occurs partly alone and partly in combination with other ores in many parts of the country; the most important deposit, at Majdanpek in Eastern Serbia, has a sulphur content of 40 to 50 per cent. Manganese ores are also found in many districts and used to be exploited at Ivancici (Sarajevo), where the mine has a modern plant for washing and separation. Antimony, mostly in the grey form, is mined in six places in the Drina Banat. Two modern smelting plants, partly using the Waelz process, work the ore up into regulus. The annual production exceeded 10,000 tons.

Bauxite Production

As to bauxite, Yugoslavia is among the richest sources of the world, taking second place in Europe after Hungary, and it is noteworthy that only a small part of the rich sources has so far been exploited. The most important deposits are on the Adriatic coast, including the islands of Krk, Rab, and Pag. At present only seven of the mines are under exploitation. The material contains on an average 53 to 55 per cent., and in some places even up to 60 per cent. Al_2O_3 , while the SiO_2 content is only 1 to 2 per cent. At Lozovac, near Sibenik, an aluminium factory has been established; exports amounted to more than 500,000 tons per annum. Magnesite represents one of the youngest branches of the Yugoslavian mining industry, yet ranks after Russia, Austria, and Greece in the fourth place in Europe. The magnesite is of excellent quality and has an average content of 92 to 96 per cent. MgCO_3 , with only 1 to 2 per cent. SiO_2 , 0.5 per cent. CaO , and 1 to 2 per cent. $\text{Fe}_2\text{O}_3 + \text{Al}_2\text{O}_3$. Exported material, partly lump, partly ground or sintered, was over 50,000 tons yearly.

Industrial Chemicals

Regarding the chemical industry, it can be generally stated that the most fully developed branches are those that find their raw materials on the spot, e.g., the soda industry, the carbide and nitrogen industry, the sulphuric acid, tannin, and wood-distillation

industry, etc. Various other branches of chemical industry, however, have also been developed. The yearly production of the two soda works at Lukavac and Jajce amounted to 10,000 tons of ammonia soda, 14,000 tons of caustic soda, 6000 tons of soda crystals, and 600 tons of sodium bicarbonate. Jajce also produces solid and liquid chlorine, hypochlorite of lime, and chlorine derivatives, such as tetrachlorethane, and penta- and hexachlorethane for extraction purposes; also zinc and barium chlorides, silicon tetrachloride and chlorinated rubber for the paint and varnish industry. Ferrosilicon was also produced at Jajce, while ferrochromium was manufactured at Ruse, near Maribor, in the Drava Banat. Hydrochloric acid, Epsom salts and sulphate of soda were produced in three works at Subotica, Sabac (west of Belgrade), and Hrastica (on the Sava, in Slovenia). Five plants—at Maribor, Rakovica (near Belgrade), Dugirat (near Split), and two at Zagreb were engaged in the production of oxygen and acetylene for welding.

The carbide industry employs three factories at Ruse, at Dugirat, and at Cernica; the annual total output of the three works was 170,000 tons. The carbide produced was partly used locally in the manufacture of nitrogenous manure, cyanamide, chlorine derivatives, acetylene, etc., while of the exports, which amounted to more than 10,000 tons, about 80 per cent. went to Great Britain. Ruse and Dugirat also turned out artificial manures, mostly for export, and superphosphates were produced in five works, the total production of which amounted to 20,000 tons per annum. Salt was produced from brine at two State-owned factories at Krka (Slovenia) and Simin Han (Bosnia). Total production was 60,000 raw and table salt and 9000 tons of iodised salt per annum. Half the brine went to the soda works at Lukavac. The well-developed sulphuric acid industry was represented by seven works, four of which also produced copper sulphate and iron sulphate.

In the organic chemical field the wood distillation and tanning industry were of outstanding importance, thanks to the abundance of forest trees. Acetone, used in the artificial silk industry and for explosives, represented an important export commodity, as well as methyl alcohol and acetates.

Successful development on a commercial scale of a resin-impregnation treatment for hardening wood has been announced by the Du Pont Company of New York. The wood is steeped under pressure in a mixture of urea and formaldehyde, which greatly increases the hardness and makes the wood resistant to heat, moisture, and many chemicals. It is claimed that the cost of the process is from $3\frac{1}{2}$ to $4\frac{1}{2}$ cents per board foot.

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Superphosphate and Basic Slag

A Survey of Relative Values

by M. LERNER, F.C.S.

SUPERPHOSPHATE is essentially a mixture of monocalcic phosphate and calcium sulphate. It is acid in character. It is particularly useful when immediate effectiveness is required. It is not absorbed directly by the roots. It is rendered insoluble in water when the soil constituents react with it, particularly if the soil contains plenty of chalk. However, the precipitated phosphate is well spread out in a fine state of division and is therefore readily available to the acids of the root sap.

Though beneficial in connection with the establishment of seedlings, it is less good in soils deficient in lime and rich in humus such as some moorland soil. For these, treatment with superphosphate simultaneously with lime is called for. For this purpose superphosphate which has been made alkaline by the admixture of lime in slight excess of that necessary to convert the monocalcic phosphate into dicalcic phosphate, will come in useful. "Basic Superphosphate," as suggested by John Hughes, will meet the case. Also, flue dust from ferromanganese or basic pig-iron furnaces, which has a fairly high content of lime, has been used successfully in simultaneous application with superphosphate by combined drill, for wheat, oats, barley, flax, and peas. It should be noted that no prior compounding took place and the mixture was applied at the same time as the sowing was done.

In experiments carried out on normal soils it was found that the pH value of the soil as a whole was not materially decreased by treatment with superphosphate, though it is not a good idea to use it on soils that are at all acid in character, or with crops that are very sensitive to acid conditions. Its response to the addition of lime has been demonstrated by experiments carried out in New Zealand over a period of eight years mainly in order to study the increase and the movement of phosphate due to the addition of superphosphate, basic slag, and Gafsa phosphate respectively. With regard to the first two the fertilisers used had the following analysis:

	Total P_2O_5 per cent.
Superphosphate ...	22.0
Basic Slag ...	16.1

in each case, one lot receiving an initial application of 1 ton per acre of carbonate of lime followed by yearly applications of 3 cwt. per acre in the case of both the superphosphate and the slag. The soil was analysed at various depths: (a) 0-2 in.; (b) 2-4 in.; (c) 4-6 in.; (4) 6-10 in. The results showed that there is little difference between the straight phosphatic treatments so far as retention of total phosphate and citric-soluble phosphate are concerned, nor in the rate at which the phosphate passes downwards.

In the plots that received the addition of the chalk as well as the phosphate it was found that there was an increase in the amount of phosphate retained in the soil as compared with the slag to which the addition of the carbonate made no difference. It was proved, incidentally, that the differences between the action of the two fertilisers in this respect were not due to increase in pH value of the soil by the addition of the carbonate to the superphosphate. Although it does not appear to be stated definitely, the inference is that the crop yield was greater with superphosphate + carbonate than in the case of slag + carbonate.

Basic Slag

Basic slag is more complicated in composition and contains lime, magnesia, alumina, iron oxide, manganese oxide, silica, and various combinations of these with phosphoric acid. It is alkaline in character. It should have a good citric-soluble phosphate: preferably not less than 75 per cent. of the P_2O_5 should be soluble in 2 per cent. citric acid—although the Ministry of Agriculture states that good working can be obtained with a smaller percentage—but the proportion should not be less than about 50 per cent. Basic slag is useful on soils that are at all acid in character, though it may not be quite so quick-acting as superphosphate. It can be specially recommended for many heavy soils deficient in lime and containing acid vegetable matter, and is of value in increasing the quantity and quality

Citric Soluble (in 1 per cent.)	Water Soluble
20.3	20.3
13.1	—

The applications were made in the following proportions per annum: superphosphate, 448 lb. per acre; slag, 618 lb. per acre. The plots were divided into two lots

of the herbage on poor grassland. It increases the fertility of the soil if applied over a regular period.

The table overleaf indicates the move-

Approximate Trend of Prices in the U.K.

	Superphosphate.	f.o.r. per ton.	Basic Slag.	f.o.r. per ton.
February, 1943	16% P_2O_5	£3 0 0	11% P_2O_5	£1 9 0
December, 1943	18% P_2O_5	£5 5 0	11% P_2O_5	£2 10 6
	16% P_2O_5	£5 0 6	16% P_2O_5	£3 4 6
	Increase :	66%		42%
March, 1944	18% P_2O_5	£5 10 0		
	16% P_2O_5	£5 5 0		
	Increase :	75%		

ment of the prices of the two fertilisers in recent months. The steeper rise in the price of superphosphate is presumably due to the fact that superphosphate is a manufactured product based on imported raw material, with all its inherent complications adding to the cost, whereas basic slag is made from a waste product from home sources of supply.

In conclusion, the author wishes to acknowledge the valuable information and assistance given him by Mr. W. M. Seaber, B.Sc., F.R.I.C., F.C.S.

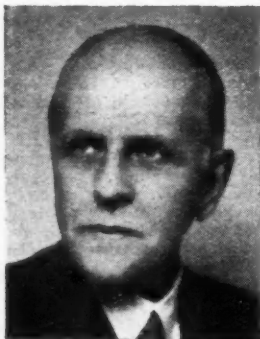
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Plastics Group

Increased Membership : New Officers

IN the secretary's annual report for 1943-44, circulated prior to the general meeting on May 8, exceptional progress is recorded in the Plastics Group of the Society of Chemical Industry. An important feature has been the establishment of closer contact with group representatives of the Plastics and of other groups of the Society in the provinces, which, it is hoped will lead to a widening of interest. Membership increased from 410, in April last year, to 513



Mr. A. J. Gibson.

this year. Improved contact with the Institute of the Plastics Industry was achieved through the appointment of Mr. E. J. Wilkins (of the Group's committee) as liaison officer between the two bodies. A tentative scheme for setting up research fellowships at universities and technical colleges has been submitted to the Institute for consideration.

The committee has appointed the following officers for 1944-45: *Chairman*, Mr. A. J. Gibson; *Vice-chairman*, Mr. N. J. L.

Megson; *Hon. Treasurer*, Mr. Austin Lowe; *Hon. Recorder*, Mr. J. Idris Jones; *Hon. Secretary*, Dr. S. H. Bell; *Hon. Hospitality Officer*, Mr. H. Langwell. Mr. E. G. Couzens, as immediate past chairman, remains on the committee. Among the ordinary members of the committee, Mr. H. V. Potter and Dr. W. G. Wearmouth have resigned at their own request, Mr. C. Diamond retires on length of service, and Mr. Lowe has become hon. treasurer. To fill the four vacancies thus caused, the committee has co-opted Dr. J. E. Sisson and Mr. Foster Sproston, while two other members will be declared elected at the annual meeting. Balloting is proceeding for the five candidates who have been nominated, namely: Mr. E. A. Bevan (Beck, Koller & Co., Ltd.), Dr. K. W. Pepper (Chemical Research Laboratory, Teddington), Dr. H. P. Staudinger (Distillers' Co., Ltd.), Dr. R. J. Tudor (India-Rubber, Gutta-Percha, and Telegraph Works, Ltd.), and Dr. V. E. Yarsley (Plastics Consultant).

Non-Ferrous Smelters

Association Formed

THE formation of an association comprising the British smelters of aluminium, antimony, magnesium, tin, zinc, and the precious metals, to consider and further common interests in the maintenance and development of the non-ferrous smelting industry in Britain is announced.

The following companies are members of the association: The British Aluminium Co., British Tin Smelting Co., Capper Pass & Son, Consolidated Tin Smelters, Goodlass Wall and Lead Industries, Imperial Smelting Corporation, Johnson, Matthey & Co., Magnesium Elektron, and South Wales Aluminium Co. The names of the chairman and secretary will be announced later.

Parliamentary Topics

Patent Law Reform

IN the House of Commons last week, Mr. Alfred Edwards asked the President of the Board of Trade whether he was now in a position to make a statement with regard to Patent Law reform.

Mr. Dalton: Yes, Sir. After consulting the Lord Chancellor, I have appointed a Committee with the following terms of reference: "To consider and report whether any, and if so what, changes are desirable in the Patents and Designs Acts, and in the practice of the Patent Office and the Courts in relation to matters arising therefrom."

"In particular, the Committee is requested to give early consideration to, and to submit an interim report or reports on: (a) the initiation, conduct and determination of legal proceedings arising under or out of the Patents and Designs Acts including the constitution of the appropriate Tribunals; and (b) the provisions of these Acts for the prevention of the abuse of monopoly rights; and to suggest any amendments of the statutory provisions or of procedure thereunder which, in their opinion, would facilitate the expeditious settlement and the reduction of the cost of legal proceedings in patent cases and would encourage the use of inventions and the progress of industry and trade."

Mr. Edwards: Is it right to say that the necessity for this inquiry arises out of the misuse of the present patent law, whereby people take out patents to prevent development and progress, rather than to utilise them for those who want progress?—Mr. Dalton: That view is very widely held, and because it is widely held and because, if it is true, it is a serious matter, I have decided to appoint this committee.

The membership of the committee is as follows:—Mr. Kenneth Swan, K.C. (chairman), Mr. Hubert Gill, Mr. James Mould, Captain B. H. Peter, Dr. David Pye, Mrs. Joan Robinson, Mr. H. L. Saunders, Dr. A. J. V. Underwood.

Penicillin Monopoly Denied

Major Procter asked the Minister of Supply whether, in view of the growing feeling that the manufacture of penicillin was tending to become a monopoly of the firms in the Therapeutic Research Association, he proposed, as in the case in Canada and the U.S.A., to permit its production by all firms who wish to manufacture.—The Minister of Supply (Sir Andrew Duncan) replied that any fears of monopoly in this matter were unfounded. Firms outside the organisation in question were making penicillin and the general policy was to encourage production on the widest practicable lines.

Factory Blackout

Major Procter asked the Secretary of State for the Home Department if he was aware of the loss of health, waste of fuel and reduction of output caused by the continuance of blackout conditions during daylight hours; and if he would consult experts with a view to solving the problems of camouflage and light leakage so that healthful conditions of factory work might be restored. Mr. Morrison replied that it was the Government policy to replace permanent by removable blackout as early as possible. No point of technical difficulty arose and progress depended solely on the availability of materials and labour. The Minister of Production had the matter in hand.

Cefoil, Ltd.

Mr. M. MacMillan asked the Secretary of State for Scotland if he would make a statement on the activities and prospect of extension of the seaweed industry in the Outer Hebrides. Mr. Johnston replied that Cefoil, Ltd., were the tenants of two factories on the West Coast of Scotland. The Scottish Council on Industry, in collaboration with the commercial firms interested, including Cefoil, Ltd., were actively exploring the possibility of developing and expanding the collection and processing of seaweed in the Highlands and islands.

New Chromium-Plating Technique

Engine Cylinder Life Extended

A RECENT American development in chromium-plating technique may extend the life of engine cylinders in motor cars, aircraft, and marine and industrial engines. The process, perfected by Hendrik van der Horst, involves coating the cylinder walls with a thick layer of hard chromium applied by a special process which renders the plated surface porous. The plating exhibits exceptionally good resistance to wear and to the corrosive acids which are formed in engine combustion chambers. The porous nature of the plate enables the internal surfaces of the cylinder to retain oil like a sponge, giving rise to an even oil distribution in service.

The new process has been patented by the newly-formed Van der Horst Corporation and the deposit has been named "Porus-Krome." It is reported that up to date it has been used successfully in the engines of many combat vehicles, compressors, and stationary diesel engines working for the war effort, as well as in naval engines. Further, the New York Omnibus Corporation reports that a group of its bus engines treated with "Porus-Krome" have had a cylinder life five times the normal.

Bituminous Products

Manufacturers Form an Association

EVIDENCE of the increased attention being given to bituminous products in both war-time and post-war aspects is provided by the news of the formation of the Association of Manufacturers of Bituminous Protective Products, Ltd. The importance of the sphere for which the new Association caters is indicated by the fact that paints made from bituminous bases are available in standardised form for a variety of industrial purposes, examples being paints for drums, dipping paints for castings, waterproofing paints, and paints for interior surfaces of water-containers, etc.

The Association is the direct result of the work carried out by the Bituminous Protective Products Section of the National Federation of Associated Paint, Colour and Varnish Manufacturers of the United Kingdom. The section, during the past four years, has had under constant examination the use of bituminous materials, particularly in connection with war requirements. The work of the section, and particularly of its technical committee, has given clear indication of the important part that bituminous products are likely to play after the war, and it is expected that as an independent organisation the Association will find many opportunities of presenting the claims of these materials. The Association is affiliated to the National Paint Federation, thus preserving the continued liaison with other paint interests.

The officials of the Association are: *Chairman*, Mr. T. W. Mathias (Colas Products, Ltd.); *Hon. Treasurer*, Mr. C. Montague Smith (Burt, Boulton & Haywood, Ltd.); *Committee*, Mr. I. Cameron (British Bitumen Emulsions, Ltd.), Messrs. W. A. Edwards (Drynamels, Ltd.), E. E. Francis (Pinchin, Johnson & Co., Ltd.), S. W. Greig (British Paints, Ltd.), and A. B. C. Licence (Berry, Wiggins & Co., Ltd.). The secretary is Mr. L. J. Humphrey and the registered office is at "Cotswood," Pixham Lane, Dorking, Surrey.

Birmingham Chemists

A New House for Midland Scientists

THE possibility of providing a "Technical House," in or near the Civic Centre, to accommodate the scientific and technical bodies of the Birmingham district, was discussed at the annual luncheon of the Midland Chemists' Committee last Saturday. Mr. T. H. Gant, A.R.I.C., M.I.Chem.E., said that the City Surveyor had received the proposal for such accommodation most sympathetically, and he had presented a report on the matter to the

City Council. He believed that the Council would undertake the provision of a "Technical House" as a civic responsibility, and he thought that industry would not fail to take its share in contributing to the upkeep. Alderman Tiptaft supported the proposal, pointing out that at present there was no building in Birmingham sufficiently spacious to accommodate local scientific and technical associations. He added that, apart from the convenience to individual institutions, such a building would provide opportunity for social intercourse and discussion between technical bodies.

Mr. E. W. Salt, M.P., chairman of the Parliamentary and Scientific Committee, proposing the toast of "The Profession of Chemistry," stressed the necessity of greatly increasing, and at least doubling, the number of scientific research workers in this country. That this proposition had been accepted by responsible bodies, and by the Government, constituted a great step forward. More money, certainly, would have to be provided, but it was an expenditure that would yield substantial dividends in employment and trade. Mr. George King, F.R.I.C., responding, said that chemists welcomed that part of the Budget speech which dealt with allowances against tax liabilities in respect of research expenditure.

To conclude the proceedings Dr. R. H. Hopkins, F.R.I.C., Professor of Industrial Fermentation, Birmingham University, referred to the distinguished services rendered for over 50 years, not only to chemistry but also to the community in general, by Mr. R. B. Pilcher, Registrar of the Royal Institute of Chemistry. Mr. Pilcher, who is shortly to retire, briefly acknowledged the toast.

Cast Copper Alloys

New British Standard

A REVISION of the series of specifications for cast copper alloys, just issued by the British Standards Institution, contains, as a special feature, the inclusion of a further quality of cast alloy which is a 83/3/9/5 leaded gunmetal. The foreword indicates that this new alloy is intended for use as a substitute for the normal 85/5/5/5 alloy and is suitable for purposes where brasses of Types A and B in the series are not appropriate. The opportunity has also been taken to incorporate some modifications to the other specifications.

In view of this amplification of the series of specifications for castings, a new memorandum dealing with the conservation of tin in alloys has been prepared and is now issued with the revised specification. Copies are available from the Institution, 28 Victoria Street, London, S.W.1, price 2s.

Metallurgical Section

Published the first Saturday in the month

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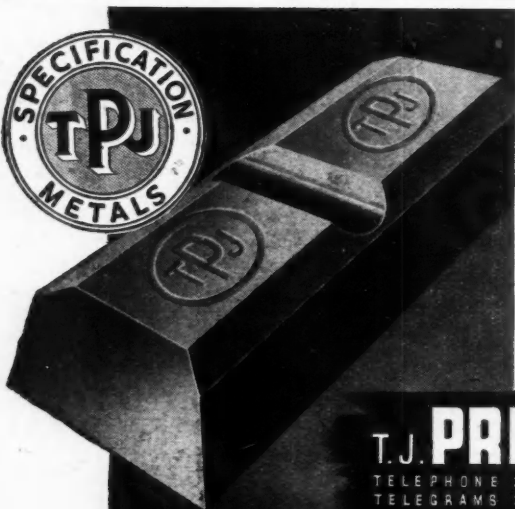
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Metallurgical Section

May 6, 1944

The Industrial Pickling of Metals

The Theory and the Practice

by P. D. LIDDIARD, B.Sc., A.I.C.*

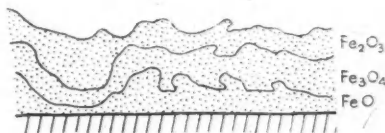
IF one were asked to define cleaning, the definition might be compactly given as the removal of unwanted material from a wanted phase. In practice the wanted phase is usually solid or pseudo-solid, whereas the unwanted materials may be either solid, liquid, or gaseous. When applying this definition to the engineering industries two distinct types of cleaning can be recognised. They are usually distinguished as degreasing and pickling. The former covers a wide field embodying the removal of oils, greases, and such accumulations of organic materials, which result from products used to assist in the fabrication of the metal. On the other hand, pickling involves the removal of reaction products of the metal itself. Examples of these reaction products are heat scales, rust, metallic sulphides, etc. Degreasing is carried out conveniently by alkaline solutions, usually with the addition of surface active agents, or by solvents; whereas pickling is done by means of acids. It is this latter practice with which this article is concerned.

Theoretical Considerations

According to modern theories of pickling the process is considered to be rather an electro-chemical action than a simple chemical one. Many phases of pickling which were once considered to be the simple solution of a metallic oxide, sulphide, etc., in an acid solution, are now known to be more complex, involving the transfer of electric charges, the setting up of secondary cells, and the solution of the reaction products of these cells. Thus, for example, the removal by means of hydrochloric acid of a scale produced by the heat-treatment of steel is not so simple as might at first be imagined when purely chemical considerations are studied.

1. *Chemical Theories*: In the first place the scale is not homogeneous but is made up of two or three of the oxides of iron. These oxides are ferrous oxide (FeO), ferric oxide (Fe_2O_3) and one approximating to magnetic oxide of iron, alternatively known

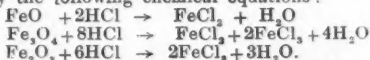
as ferroso-ferric oxide (Fe_3O_4). When all three oxides are present they are found in the following order: the ferrous oxide is adjacent to the iron, the ferric



STEEL

Fig. 1.

oxide is on the outside, and sandwiched in between is the ferroso-ferric oxide. This construction to the scale was first put forward by Winterbottom and Reed¹ and is shown diagrammatically in Fig. 1. Simple solution of this scale would be represented by the following chemical equations:



The ferric chloride might then be considered to become reduced to ferrous chloride by the nascent hydrogen evolved by the action of the acid on the exposed iron surface. However, the process is far more complex than these simple formulae indicate.

The ferric oxide and the ferroso-ferric oxide are in practice found to be relatively insoluble in hydrochloric acid, and even less soluble in sulphuric acid, and it is often possible to remove large flakes of undissolved oxide scale from the bottom of a pickling vat after work has been through it. Ferrous oxide, on the other hand, is readily soluble in acid solutions. It was once thought that the acid seeping through cracks in the scale would attack the steel, giving rise to hydrogen, and that the evolution of this gas would mechanically dislodge the more insoluble parts of the scale. This theory breaks down when the question of inhibitors is considered. This will be mentioned later, but it can be pointed out here that inhibitors protect the steel from the action of the acid, preventing gaseous evo-

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lution, but this does not materially slow down the removal of scale.

2. *Electro-chemical Theories*: The chemical picture is further complicated by the study of heat scales produced below the temperature of 570°C . Examination of these scales shows that the ferrous oxide layer is practically, and in many cases entirely, absent. The remaining two oxides, as stated above, are relatively insoluble. It is recognised that such a scale is more difficult to remove but nevertheless successful pickling does occur even in the absence of the more soluble ferrous oxide layer. In order to explain the removal of these scales it is necessary to put forward electro-chemical theories. T. P. Hoar² has suggested that a simple electrolytic cell is set up in which the pickling solution acts as the electrolyte. The steel surface becomes the anode and the iron oxide deposit becomes the cathode.

In the absence of ferrous oxide the cathode surface will be mainly of ferroso-ferric oxide. The hydrochloric acid, if this is the acid being used, will ionise, giving positively-charged hydrogen ions and negatively-charged chloride ions, the former being at-

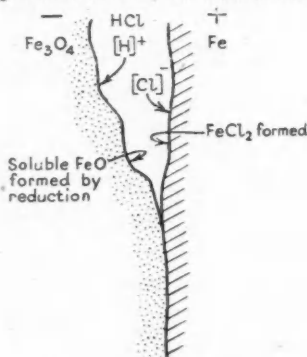


Fig. 2.

tracted towards the cathodic scale, the latter moving towards the anodic iron. The hydrogen ions will release their positive charges and the nascent hydrogen will combine with the scale, reducing the ferroso-ferric oxide to ferrous oxide. The solubility potential of this product will be rapidly exceeded and it will pass into solution. As this occurs, the acid will penetrate further into the scale, thus dislodging the outer more insoluble deposits from the steel surface. On the other hand, the negatively-charged chloride ions will give up their electrons at the anode surface and will combine with the iron, giving ferrous chloride which will pass into solution. It should be noted that at this stage there will be no

evolution of hydrogen at the iron surface. Again, this theory will also account for the continued pickling in the presence of an inhibitor covering the surface of the steel. Fig. 2 gives a diagrammatic representation of this.

Alkaline Pickling

An acid solution is usually required for the electrolyte. Certainly this is necessary in the pickling of iron, since an alkaline solution would give rise to hydroxyl ions which, instead of being released, would form insoluble hydroxides that would coat the anode surface and form a polarising layer, thus reducing the efficiency of the cell. The result would be a static cell with no solution of the scale.

In some systems, however, an alkaline pickling solution could operate; thus, for the removal of zinc oxide from a zinc surface, caustic soda is successful, and in this case the formation of soluble sodium zincate by solution in caustic soda of the water-insoluble zinc hydroxide which could form as an intermediate product, results in the maintenance of the electrolytic efficiency of the system. This will apply to metals having amphoteric oxides.

The systems covered above are simple electrolytic cells with dissimilar materials as the electrodes in a common electrolyte. The electrodes might be dissimilar metals, as, for example, copper and zinc in brass, in which the copper acts as the anode, being more strongly electro-positive than zinc. The copper tends to plate out on the zinc, being dissolved from the copper end of the dipole, and it is often noticed in faulty brass-pickling that bright copper flashes can occur on the work.³ At the same time the copper, being anodic, will be the point at which oxygen will be released. In practice, the oxygen combines with the copper to give copper-oxide deposits under some conditions. These brownish stains are sometimes seen on the work where uneven pickling is taking place. Again, in non-ferrous pickling, accidental contact of iron with the metal being pickled may give rise to uneven action on the metal, often resulting in dark areas, again where oxidation has taken place. Iron holders and jigs cannot be employed in brass pickling for this reason, although some stainless steels are satisfactory. If, however, the stainless-steel is previously annealed with the work before pickling it will then act as ordinary steel and give rise to discoloration of the work.

Faults in pickling have sometimes been attributed to the setting up of concentration cells. Here the electrodes may be of the same metal but with the difference in potential resulting from contact with a solution of varying concentration. Fig. 3 shows the effect of this system in copper pickling, there being two concentrations of the pick-

ling acid. The copper adjacent to the stronger concentration becomes the anode from which copper will pass into solution, whereas the copper in contact with the weaker solution becomes the cathode and will have copper plated out on to it. This system may operate far more widely in metal pickling than has previously been realised and may account for much of the uneven pickling which sometimes is to be observed where dormant immersion treatment is used.

Acids Used in Pickling Solutions

Oxides and sulphides are generally the more important materials to be removed. Chlorides occur in marine atmospheres, but on the whole pickling is generally required to deal with the oxides, from the heat-treatment of metal surfaces; or oxides, basic carbonates, and sulphides on surfaces exposed to the atmosphere.

Carbon may also need to be removed in the pickling process. It arises from the decomposition of oils, etc., used in metal fabrication and decomposed during heat-treatment of the metals. Although not soluble in pickling acids, carbon is nevertheless removed in this process by mechanical action such as gaseous evolution or removal of other products present on the surface with disruption of the carbon films. For these processes, acids are employed. The two most usually used are sulphuric and hydrochloric acids. In certain circumstances nitric acid, hydrofluoric acid, and phosphoric acid may be used, as well as pickling adjuncts.

Commercially, the most economic acid is sulphuric; it is cheap and readily obtained. The commercial acid is 95 per cent. H_2SO_4 . Iron scales are less soluble in sulphuric acid than in hydrochloric acid, but when used at elevated temperatures splitting of the scale occurs, as previously described. This temperature effect is more noticeable when using sulphuric acid than with hydrochloric acid, and, since less scale dissolves, the active acid strength is maintained for a longer period. Increase in concentration of the acid brings about a corresponding decrease in pickling time until 25 per cent. sulphuric acid is reached; then there appears to be a rise in the time, viscosity possibly playing some part. The formation of ferrous sulphate in solution retards the rate of pickling, and methods are often used to remove it from solution. Sulphuric acid is used for ferrous pickling and for brass pickling where bright surface is not required.

Hydrochloric acid is often preferred for ferrous pickling because it can be used cold. The commercial product contains about 35 per cent. hydrochloric acid. It can be used warm, but not hot, because of the excessive loss by evaporation of the constant boiling mixture. The temperature effect is not so pronounced as in the case of sulphuric acid,

but the concentration effect is more noticeable. Sulphuric and hydrochloric acids may

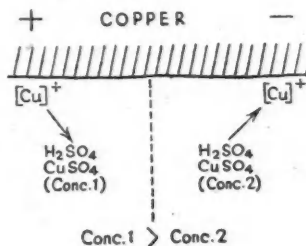


Fig. 3.

be mixed, and one such process, the De Lattre process, has been described by McLeod.⁴

Phosphoric acid is employed for iron and steel and sometimes for aluminium, but on the whole it is an expensive acid to use. The commercial form contains 60 per cent. of H_3PO_4 , although more concentrated syrupy forms can be obtained. A 10 to 20 per cent. solution is used in practice, hot or cold according to the work to be treated. It has an advantage over sulphuric and hydrochloric acids in that it is non-rusting, forming a temporary protective film of iron phosphate on ferrous surfaces. With hydrochloric and sulphuric acids the freshly exposed metal surfaces oxidise rapidly in the moist air, particularly in the presence of acid residues; but with phosphoric acid rusting does not occur until a much later stage when the iron phosphate has been attacked.

Nitric acid is obviously not a convenient acid to use, since the oxides of nitrogen which are given off make it very unpleasant to handle. It is necessary to use it in stainless steel-pickling to dissolve the more difficult oxides of nickel, chromium, etc., and it is used in the pickling of copper and its alloys, as for example in the bright pickling of brass. With nitric acid alone a concentration below 30 per cent. is ineffective on brass. If, however, one-sixth of the volume of sulphuric acid is added, 25 per cent. is the minimum concentration of nitric acid, and with one-third of the volume of sulphuric acid, 10 per cent. is the minimum effective concentration. The addition of sulphuric acid decreases the initial rate of attack on the metal. Mixed pickles contain nitric and sulphuric acids, often with the addition of hydrochloric acid, and are used on brass; and it has been stated that the rate of solution of copper varies directly with the concentration of nitric acid, and the rate of solution of zinc varies directly with the concentration of hydrochloric acid. The presence of sulphuric acid and the tem-

perature affect the velocity of the dip, but above 50°C. all these mixtures decompose rapidly.

Hydrofluoric acid is not used alone, but sometimes with nitric acid in stainless steel pickling. It also finds use in the removal of silica from sand-cast work. Such solutions are usually used warm. In the case of the stainless steels, it is the oxides and carbides of chromium, nickel, cobalt, etc., which render the steel stainless. They are very resistant to corrosion and are thus very difficult to remove by pickling. Pickling acids for these materials usually contain oxidising agents to oxidise the lower oxides of the metals up to the more soluble higher oxides.

Pickling Adjuncts

Various addition agents are nowadays added to the straight pickling acids in order to increase their effectiveness.

1. *Brightening Agents* are added, for example, in brass pickling. They are usually oxidising agents, and much of their action is due to the conversion of the lower, less soluble, cuprous oxide to the more soluble cupric oxide, resulting in more even pickling of the work. In the case of brass pickling some success can be obtained by the simple expedient of bubbling air through the pickling solution. This will have the dual effect of getting the solution saturated with oxygen, and of preventing the formation of concentration cells, such as would develop in a more static bath. Results with agitated immersion are always more satisfactory than in a static bath. Oxidising agents used are nitric acid, as already described; chromic acid, usually produced *in situ* by the addition to the acid pickle of sodium chromate or sodium dichromate; and ferric sulphate. The latter is milder in its action than nitric and chromic acids and is finding extended use in non-ferrous pickling. It has only recently been made commercially available in this country. It is also used with hydrofluoric acid in stainless steel pickles, replacing nitric acid. With a dichromate bath the surface produced on brass is very bright and yellow but has a certain roughness. It also has an extremely hard skin which makes the metal unsuitable for further fabrication, e.g., drawing, since the die wear is tremendously increased. When ferric sulphate is used instead, drawing is considered to be better. The more natural brass colour is obtained with the latter bath. Small additions of organic acids are sometimes made to ferric-sulphate pickling baths, among these being acetic acid, citric acid, glycolic acid, and adipic acid. These add to the brightening effect and give some control to the resulting colour. In general the ferric sulphate bath contains 10 per cent. of ferric sulphate and 10 per cent. of sulphuric acid.

2. *Inhibitors* have been added to pickling acids for many years now. Their purpose is to reduce attack upon the metal itself without affecting the rate of removal of the scale. The materials are organic, and in the past were taken from a variety of organic groups. They included glues, liquorice, glucose, and some resinous materials. Nowadays, the range of effective inhibitors has been considerably narrowed, and they are mainly nitrogen compounds, particularly with pyridine groupings. The most usually accepted explanation for their action is the formation of a colloidal film over the freshly exposed metal surface, this adsorbed layer appearing to prevent further action by the acid. At the same time it will still conduct electricity and will thus not impede the rate of scale-removal where the electrolytic theory applies; whatever the explanation of their action they can be effective at quite low concentrations, often requiring as little as $\frac{1}{4}$ lb. per 100 gallons of concentrated acid.

Since inhibitors prevent or greatly reduce the action of the acid on the metal, they will reduce hydrogen formation from this source. This has two important advantages. In the first place it reduces effervescence of the acid and the development of obnoxious mist around the bath. Secondly, it minimises hydrogen embrittlement. Hydrogen embrittlement results from the trapping of hydrogen in the metal pores. This leads to an embrittlement effect on the metal which can only be corrected by letting the metal rest for some time or by heating until all the hydrogen is driven off.

3. *Wetting Agents*. A liquid has internal cohesive forces which tend to minimise its volume. If these forces are greater than the attractive forces operating between the liquid and a solid immersed in the liquid, the latter will tend to retract away from the solid as for example, water on a greasy plate. If the tension which exists internally in the liquid can be reduced, with a consequent reduction in the tension between the solid and the liquid, the liquid will more easily "wet" the solid. Some of the more modern wetting agents are stable in acid solution. Most of them are alkyl or naphthalene sulphates or sulphonates (usually the sodium salt), and the range of choice is now very wide. Still more modern are the non-ionic wetting agents of the polyglycerol ester class. Concentrations of 0.1 per cent. or less of most of the wetting agents are required in pickling acid solutions.

REFERENCES.

- 1 WINTERBOTTOM & REED, *J. Iron and Steel Inst.*, 1932.
- 2 T. P. HOAR, *Ibid.*
- 3 CROWTHER & LIDDARD, *Sheet Metal Industries*, 1943.
- 4 MCLEOD, *Ibid.*, 1942.

Endurance of Iron Alloys

Improvements by Addition of Metals

THE chemical endurance of acid-proof iron alloys can be greatly increased by additional alloying with small amounts of metals like molybdenum, copper, and silver. For example, chromium-nickel steels subsequently alloyed with molybdenum were found to be very resistant towards saturated aqueous solutions of sulphur dioxide up to pressures of 40 atm. and temperatures of 250°C., in concentrated phosphoric acid up to 110°C., towards solutions of chlorides, bromides, and iodides, towards sulphuric acid, etc. Assuming that this effect was due to traces of molybdenum, copper, and silver ions which went into solution from the alloy, B. P. Artamonov and A. I. Shultin (*Proc. 2nd Russ. Conf. Corrosion Metals*, 1943, 2, 86-103) studied the corrosion resistance of various alloys (see Table I) in

chromium steels with 25.5 per cent. of Cr: $Ag^+ = 3 \times 10^{-4}N$ or $Cu^{++} = 2 \times 10^{-4}N$, and for chromium steel with 15.6 per cent. of Cr: $Ag^+ = 25 \times 10^{-4}N$ or $Cu^{++} = 27 \times 10^{-4}N$. At lower concentrations than these, the rate of corrosion, instead of being reduced, increases greatly. The rise and fall of the rate of corrosion in iron alloys containing such ions is apparently due to the deposition of the noble metal within the pores of the oxide film; e.g., at smaller chromium content when the film is less perfect, more copper and silver is required; this is seen from the values just given. When the film is unstable, e.g., in 2N HCl, addition of copper and mercury raises the rate of corrosion, see Table 3. As the tables show, the electrode potential at a sufficient concentration of the silver, copper, or mer-

TABLE I
Percentage chemical composition of the alloys

Alloy	C	Cr	Ni	Si	Mn
Chromium-nickel steel ...	0.10	17.8	9.01	0.81	—
Chromium steel ...	0.12	15.57	0.21	0.45	0.24
Chromium steel ...	0.10	25.47	0.23	0.43	0.23
Si-iron ...	0.69	—	—	15.64	—
Electrolytic iron ...	0.009	—	—	0.005	0.006

sulphuric, formic, and hydrochloric acids in presence of small additions of Cu^{++} , Ag^+ , Hg^{++} , Pt^{++++} , and molybdenum.

The rates of corrosion (v) of chromium-nickel steels are given in Table II. In it—

cury ions, in 2N H_2SO_4 and in 2N $HCOOH$, is nearly equal that of Ag , Cu , and Hg electrodes, and it is nearly constant during all the 200-250 hr. which the experiments last. At concentrations of the

TABLE II				
Addition	Conc. of addition	Rate of corrosion	Potential of steel	Potential of addition
Cu++	0.1	9.3	-0.215	—
Cu++	0.1	0.05	0.255	0.284
Ag+	0.0093	0.00	0.659	0.660
Hg++	0.097	0.02	0.670	0.680
—	—	22.10	—	—
Cu++	0.05	0.01		
Cu++	0.1	0.01		
Ag+	0.0093	0.02		
Hg++	0.097	0.02		
—	—	0.73	0.579	
Cu++	0.15	0.19	0.484	0.308
Ag+	0.01	0.21	0.666	0.679
Hg++	0.098	0.23	0.655	0.736

and in Table III—the concentration of addition is given in gram-equiv. per litre, and the rate of corrosion in gm./sq. m./hr. It can be seen that small additions of Cu^{++} , Ag^+ , or Hg^{++} reduce v in 2N sulphuric acid more than 100 times, and in 2N formic acid 3 to 4 times. For each alloy and for each concentration of the acid there exists a minimum concentration of metal ions nobler than iron at which the protective action appears. This is in 2N H_2SO_4 for

noble metals at which v is not reduced, the electrode potential of the steel is very nearly equal to the potential of iron, and in the case of the solution in HCl when the rate of corrosion is greatly increased by the presence of the noble metals the potential values lie between the potential of iron and the potential of the metals added, the latter being deposited in great amounts on the surface of the alloy.

The rate v of corrosion of chromium steels

in 2N H_2SO_4 with additions of molybdenum salts shows that the lower is the valency of molybdenum, the higher is v . Thus Mo^{III} raises the rate of corrosion, Mo^V lowers it, and Mo^{VI} reduces it nearly to 0. The potential of chromium-nickel steels in solution of sulphuric acid containing molyb-

kind of oxidation-reduction potential, and that high-valent molybdenum passivates iron in the same way as does nitric acid. The similarity of action between nitric acid and hexavalent molybdenum is shown by the effect of molybdenum concentration on corrosion of chromium steel containing 15.6

TABLE III

Alloy	Addition	Conc. of addition	Rate of corrosion	Potential of alloy		
				at begin.	at end	addition
Cr-Ni steel in 2N HCl	—	—	1.8	—0.196	—0.176	—0.225
	Cu++	0.097	6.1	—0.034	0.055	0.085
	Cu++	0.2	12.0	0.063	0.047	0.100
	Cu++	0.297	22.9	0.065	0.057	0.109
	Hg++	0.059	2.2	—0.033	—0.017	0.259
	Hg++	0.117	6.4	—0.013	—0.011	0.262
Si-iron in 2N HCl	—	—	0.11	—0.189	—0.080	—
	Cu++	0.297	0.78	0.147	0.636	0.109
	Hg++	0.117	0.80	0.256	0.275	0.262

denum of various valencies is equal to the potential of metallic molybdenum, and of bright platinum, only in solutions containing chiefly Mo^{III} . In all other cases the potential is lower than that for metallic molybdenum or platinum. This makes it probable that the potential measured is a

per cent. of Cr in 2N sulphuric acid. Thus v is reduced to nearly nothing when the concentration of Mo^{VI} is greater than 0.1 N but at a Mo^{VI} concentration of 0.04 N v reaches a maximum which is eight times as high as without any molybdenum additions.

The Finishing of Light Alloys

A Factor Affecting Post-War Utility

A PAPER entitled "The Finishing of Light Alloys" was delivered by Dr. L. Whitby, formerly associated with the Paint Research Association, at the recent annual meeting of the Oil and Colour Chemists' Association, London Section. The present war, he said, with its emphasis on mechanisation and aircraft, had caused enormous expansion in the production of strategic metals, particularly aluminium and magnesium, the basic materials from which the indispensable light alloys were prepared. It was now undisputed that the number and variety of finishes, both decorative and utilitarian, for light alloys far exceeded that possible with any other structural material. Those finishes were based on mechanical, chemical, electro-chemical, and organic coating methods, or combinations thereof, and were applied to improve the appearance, reflectivity, and resistance to abrasion or corrosion.

In a reference to mechanical treatment of light alloy castings, forgings, or rolled sheet, Dr. Whitby said that when a high-grade finish was required on aluminium and its alloys, the final process after tripoli buffing was known as colouring, using a soft dry mop dressed with Vienna lime or the like. It was not advisable to use rouge with aluminium alloys, since a reddish tone, difficult to remove, might be so obtained.

Dealing briefly with some of the valuable chemical surface treatments which had become standard practice for use prior to paint application, he said that such treatments were inferior to anodic oxide coatings for providing protection against corrosion, but they were adequate, when reinforced with paint, for all but severely corrosive exposure conditions. The chrome-sulphuric acid pickles, now specified in DTD 915A, had practically eliminated major paint adhesion failures on light alloys. Those pickles were used mainly on unfabricated parts; for fabricated parts which could not be totally immersed in an acid bath, proprietary pastes of the alcoholic phosphoric-acid type were efficient for pre-treatment before painting. Anodic oxidation processes had been made available which would produce either hard abrasion-resistant coatings of hardness approaching that of a diamond, or ductile, thick, porous coatings which were valuable as anti-friction surfaces, since they would hold oil most tenaciously.

The most striking advances had been made in the impregnation of freshly prepared anodic coatings with either dyestuffs or light-sensitive materials, whereby photographs, drawings, maps and the like could be reproduced on the aluminium surface in a permanent and highly durable form. Many

dyestuffs had been developed especially for use with anodized aluminium; it was not unduly optimistic to suggest that in time the range of colours non-fugitive to outdoor exposure (now confined to blacks, blues, and reds) would be considerably extended. Apart from impregnation of the anodic coatings with organic dyestuffs, however, inorganic pigments were readily precipitated in the oxide coating, e.g., cobalt oxide, prussian blue, and lead chromate. Other general properties of the anodic oxide coatings were high dielectric strength and a total absence of flaking or visible cracking when the basis metal was deformed, as, for example, by drawing or pressing operations.

Anodising Processes

Dr. Whitby discussed the various processes now used for anodising—the Bengough-Stuart (using 3 per cent. chromic acid as the electrolyte), and the German Eloxal processes (covering both oxalic acid and the Aluminite sulphuric acid electrolytes). By variation of the electrolyte and conditions of treatment, he said, the Sheperd, the Eloxal, and the Aluminite processes were patented, each with their own definite advantages over the Bengough-Stuart process, gained not by increasing corrosion resistance so much as by the wide variations possible in the absorptive powers of the coating or in its hardness and thickness.

Sulphuric acid electrolytes were particularly valuable for the production of oxide coatings with high abrasion-resistance. Impregnation or sealing by soluble dichromate of the hard, moderately thick, anodic coatings produced by sulphuric acid electrolytes resulted in coatings having corrosion-resistance probably greater than that given by any other anodic process. Sealing was essential with sulphuric acid electrolyte coatings, if the full degree of corrosion-resistance was to be obtained. When first produced, the oxide was somewhat porous, but when sealed by steam, hot water, or hot aqueous solutions, it became partly hydrated and many of the pores were closed. For coatings of the highest abrasion-resistance the sealing treatment should not be applied, since the hydration of the oxide tended to lower its abrasion resistance.

Dr. Whitby also referred to paint coatings, pointing out that the durability and protective value of paints applied to most metals depended upon the method of pre-treatment of the metal surface. With light alloys, provided that the metal was adequately cleaned and suitably pre-treated (either by anodic treatment, or by the use of a chemical etch, such as DTD 915A chrome-sulphuric acid pickle), the adhesion of paints was adequate for most service exposure conditions. The relatively high coefficient of thermal expansion of light alloys

was sometimes claimed as necessitating special formulation of the paints to provide sufficient extensibility in the latter to accommodate the stresses imposed as a result of temperature fluctuations. Examples of paint failure which could be traced to those factors were, however, rare.

In general, special paints need not be provided for aluminium alloys unless corrosive conditions were severe, when a proportion of zinc chromate in the primer was to be recommended. Lead pigments were generally considered with some suspicion owing to danger of galvanic action due to precipitation of metallic lead, should soluble lead compounds react with metallic aluminium. That danger had been overstressed; nevertheless, heavy pigments should be avoided in paints for light alloys owing to the extra weight so imposed.

Magnesium-Base Alloys

In the case of the ultra-light (magnesium-base) alloys, which were 33 per cent. lighter than aluminium-base alloys, surface treatments were applied primarily for protection against corrosion. In saline or acidic conditions severe corrosion often occurred unless the metal was protected. The pioneer work of Hanawalt, Nelson, and Peloubet in the U.S.A. indicated that magnesium, when sufficiently free from certain metallic impurities usually present, was inherently non-corrodible by chloride solutions. The solution of the corrosion problem with magnesium, therefore, might be in sight and would probably be found in the removal of traces of those metallic impurities which formed active cathodes; those metals were mainly iron, nickel, and, to a lesser extent, copper, and their tolerance limits both in magnesium and in its alloys with aluminium, manganese, and zinc had been determined.

In exposure conditions not involving salt spray or polluted industrial atmospheres, paint coatings possessed normal durability on magnesium alloys, provided that the latter had been pre-treated adequately. Under severe conditions, however, special priming paints containing a generous proportion of zinc chromate in the pigment were necessary to inhibit corrosion and hence to prevent the paint from being removed piecemeal by hydrogen evolution and the formation of bulky corrosion product at the paint/metal interface. Neither paint systems nor chemical nor electrolytic surface treatments alone would give adequate protection to magnesium alloys exposed to salt spray or sea-water. In combination, however, special priming paints with water-resistant finishing coats over certain pre-treatment coatings would provide a high order of protection. The final solution of the corrosion problem, however, would depend on the metallurgist.

Iron-Rich Nickel Alloys

Recent Russian Researches

IN spite of the extreme importance of iron-nickel alloys, the metallographic properties of the iron-rich alloys are not yet known with complete certainty. In a recent paper by A. T. Grigoriev and D. L. Kudriavtzev (*J. Prikladnoi Khimii*, 1942, 15, 204) these alloys were investigated by using the methods of dilatometric analysis, Rockwell hardness, electric resistivity, and the microstructure. The alloys were investigated only up to 30 per cent. by weight of Ni as it was found that at higher nickel contents no transition of the $\alpha \rightleftharpoons \gamma$ type could be detected. The following data refer to material annealed for 5 hrs. at 1100°C. The few observations made on cast alloys are in agreement with the results for the annealed samples.

Dilatometric analysis was carried out on a Chévenard dilatometer with photographic recording. Some results are given in Table I.

TABLE I

Temperature of transition for $\alpha \rightleftharpoons \gamma$

Weight % Ni	Temp. on heating		Temp. on cooling	
	start	finish	start	finish
3.17	730°	830°	730°	680°
9.82	575°	725°	535°	380°
16.27	500°	660°	355°	200°
26.72	450°	600°	120°	—
28.21	—	—	—	—

The $\alpha \rightarrow \gamma$ temperature curve was in full agreement with previous investigations, while the reverse $\gamma \rightarrow \alpha$ transition took place at higher temperatures than those formerly found and, presumably, was nearer to the equilibrium temperatures. The concentration of 28.21 per cent. of nickel apparently was already too large for the transition to be observed.

The Rockwell hardness increases with the Ni content, and at 16.18 per cent. of Ni reaches a flat maximum, then slowly decreases and at about 27 per cent. of Ni rapidly falls to a minimum at 28 per cent. of Ni, whereafter it rises again. See Table II.

TABLE II

Weight % of Ni	Rockwell Hardness	Spec. Electric Resistivity		Temperature Coefficient $\left(\frac{S_{100} - S_{25}}{S_{25} \times 75}\right) 10^5$
		$S_{25} \cdot 10^6$	$S_{100} \cdot 10^6$	
0.00	—	10.45	15.08	692
3.17	14.0	17.49	21.15	300
9.82	36.0	25.87	29.93	222
16.27	46.5	31.09	35.80	212
26.72	39.5	49.53	51.50	72
28.44	7.0	72.19	76.75	87
30.32	19.5	72.12	80.15	154

The electrical resistivity was measured at

25° and 100°C. At both temperatures it rose to a flat maximum at about 20 per cent. of Ni, passed through an insignificant minimum at about 25 per cent. and then rose steeply again. See Table II.

The curve of the temperature coefficient falls rapidly at the first additions of Ni to iron then slowly rises and reaches a maximum at about 25 per cent. of Ni after which it falls rapidly, reaches a minimum, and rises again. The minimum and the maximum at 25 per cent. could be considered to confirm the existence of a chemical compound Fe_3Ni (with 25.9 per cent. of Ni), but as there is no singularity at this composition in the dilatometric curves, it is perhaps more probable that at 25 per cent. of Ni, at these temperatures, the γ -phase appears.

The microstructure shows that at 28.44 per cent. of Ni not only fields showing the $\gamma \rightarrow \alpha$ transition, but also those of the γ -phase are visible, the latter being stable at room temperature. Only at about 30 per cent. of Ni is the γ -phase alone observed. It should be added that Bradley and Goldschmidt (*J. Iron and Steel Inst.*, 1939, 140, 11) found indications of a two-phase region even at 40 per cent. of Ni.

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Personal Notes

MR. C. M. WHITTAKER has been appointed a director of Courtaulds, Ltd.

SIR GEORGE NELSON was elected president of the Federation of British Industries for a second year, on April 27.

MR. W. H. HOLMES has been elected to the vacancy on the committee of the Bristol and S.W. Counties section of the Royal Institute of Chemistry.

SIR VYVYAN BOARD, Senior Economy Officer of the Ministry of Supply, has been appointed Rubber Controller in succession to Col. E. Gore-Browne, who has been elected chairman of the Southern Railway.

At the annual meeting of the Midland Section of the Institute of the Plastics Industry the following officers were elected: *Chairman*, MR. A. H. WILSON; *vice-chairman*, MR. F. L. DINENAGE; *hon. secretary*, MR. C. F. HUGHES.

DR. A. H. COOK has been appointed to represent the Royal Institute of Chemistry on the committee of the British Chemical Ware Manufacturers' Association dealing with "Master Key" Industries (Laboratory Equipment).

MR. S. J. TUNGAY, M.I.Chem.E., chairman of the Chemical Engineering Group, S.C.I., was installed Warden of the Worshipful Company of Fletchers, at a meeting held at Innholders' Hall, London, on April 28.

MR. ALEXANDER JOHNSTON, managing director of the North British Rubber Co., Ltd., has been elected president of the British Rubber and Allied Manufacturers' Association, in succession to Sir Walrond Sinclair. MR. R. H. COMLEY and MR. H. L. KENWARD have been elected senior and junior vice-presidents respectively.

The following are the new Members of Council of the Royal Institute of Chemistry, elected at or since the last annual meeting: MR. R. C. CHIRNSIDE, MR. ARTHUR CHURCHMAN, MR. J. C. COWAR, DR. J. F. J. DIPPY, MR. T. H. GANT, M.I.Chem.E., PROFESSOR J. M. GULLAND, DR. D. H. HEY, DR. HAROLD HUNTER, MR. J. W. KERR, MR. G. ROCHE LYNCH, O.B.E., DR. W. S. PATTERSON, SIR ROBERT PICKARD, F.R.S., and DR. J. H. QUASTEL, F.R.S. They replace the following, who were not re-elected or have resigned: MR. R. W. ANCRUM, MR. E. E. AYLING, DR. H. BAINES, DR. S. R. CARTER, DR. F. CHALLENGER, DR. J. W. COOK, F.R.S., DR. E. L. HIRST, F.R.S., DR. L. A. JORDAN, DR. J. G. KING, DR. J. A. LOVERN, Vice-Chancellor J. I. O. MASSON, Mr. Garfield Thomas, and Dr. F. J. Wilson.

Obituary

The name of the Lyons chemist whose death we recorded in our issue of April 22 (p. 397) should have been MR. ROBERT OWEN JONES, B.Sc., A.R.C.S., D.I.C.

MR. FREDERICK CHARLES BLYTHE, late of William Blythe & Co., died at Bexhill, Sussex, on April 27, aged 85. Son of the founder of the company, the late Mr. William Blythe, he was managing director until just before the last war when he retired. At the outbreak of hostilities he returned to the firm, to take over while his son, the late Mr. Lancelot Blythe, was in the Army. After the Armistice he relinquished the managerial control, and was succeeded by another son, Mr. F. E. F. Blythe, and Mr. W. Collison, who are joint managing directors.

DR. JOHN KEITH ROBERTS, Sc.D., F.R.S., who died in London on April 26, aged 47, was assistant director of research in colloid science at the University of Cambridge. He was born in Melbourne, Australia, and was educated at Melbourne and Cambridge Universities. After experience as demonstrator in physics at Melbourne, he came to England, and served as assistant in the physics department of the National Physical Laboratory before receiving his Cambridge appointment. He was a Fellow of Christ's College, Cambridge, and was elected F.R.S. in 1942. His publications included *Heat and Thermodynamics and Some Problems in Absorption*.

CHEMICAL TECHNOLOGY IN BOMBAY

The Department of Chemical Technology of the University of Bombay, which was founded in 1934, has now, thanks to the munificence of the P. G. Singhanee Trustees, been installed in a habitation of its own, albeit still incomplete. The new building, at Matunga, will contain sections devoted to *Pharmaceuticals and Fine Chemicals*, the *Chemistry of Food and Drugs*, and the *Technology of Intermediates and Dyes*, as well as the *Textile Chemistry* and *Chemical Engineering* sections which are already functioning. The Indian Government's Council of Scientific and Industrial Research is making a substantial annual grant to the Intermediates and Dyes section, while a further endowment of Rs. 7,000,000 from Sir Homi Mehta will enable advanced teaching and research in other branches of chemical technology to be undertaken shortly. Further details of the department are available in *J. Sci. and Indus. Res.* (issued by the Council of Scientific and Industrial Research, India), 1943, 2, 1, p. 24.

General News

Negotiations are going on between the Ministry of Supply and United Dairies, Ltd., with regard to the possibility of this company making penicillin, reports the *London Evening Standard*.

The salting of hay, to the extent of 20-40 lb. of ordinary agricultural salt per ton, is recommended by the Ministry of Agriculture to prevent overheating due to excessive fermentation.

The Streatfield Memorial Lecture, by Dr. P. A. Houseman, entitled "Licorice: Putting a Weed to Work," has now been published by the Royal Institute of Chemistry as a separate booklet, price 2s.

A Carnegie Trust grant of £11,040, for the new Chemistry Institute at Glasgow University, is mentioned in the University's annual report. The grant covers the year ending September 30, 1944.

The only changes in the existing prices of refined oils and imported edible animal fats allocated to primary wholesalers and large trade users during the eight-week period, April 30 to June 24, are: Empire edible tallow, reduced by £3 per ton to £48 10s.; South American edible tallow, reduced by £3 per ton to £51 15s.

A municipal department of industrial research should be set up in Glasgow, suggested Councillor G. Smith at last week's meeting of the City Corporation. He thought such a department might be useful in promoting development that would accord with schemes of national or regional planning. It was agreed that the Corporation's special committee on post-war planning should investigate this proposal.

The Stationery Office has just published the following D.T.D. Specifications: 181A, Non-Corrosible Steel Flexible Wire Rope, Amendment List, No. 2; 364A, Aluminium Alloy Bars, Extruded Sections and Forgings, Amendment List, No. 2; 610, Aluminium-coated Aluminium Sheets and Coils (Solution Treated), Amendment List, No. 1; 663, Lanoline Resin Protective. The last-named costs 6d., the others 1d. each.

The 1943 volume of *Abstracts bearing on Shellac Research Literature* is now obtainable from the London Shellac Research Bureau, India House, Aldwych, W.C.2. Other recent publications of the Bureau are: *Bulletin No. 6*, "Ethylene Glycol Ester of Hydrolysed Lac," by N. R. Kamath; *Technical Paper No. 23*, "Ethers and Ether-Esters of Lac and their Polymerisation, Pt. II," by Gidvani and Kamath; and *Technical Paper No. 24*, "Plasticising Lac Films from Aqueous Solutions, Pt. I," by B. S. Gidvani.

From Week to Week

The Minister of Agriculture states that appreciable quantities of the powder used by farmers to protect their stock against the attacks of the warble fly should be available next year. He added that this powder is used very largely for horticultural purposes and also by the Army for delousing.

The West African Produce Control Board now purchases groundnuts, palm oil and kernels, copra, benniseed, and ginger, and sells them to the Ministry of Food at the average estimated cost so that no question of profit arises. This statement was made by the Secretary of State for the Colonies last week.

A brochure descriptive of its aims and activities is about to be issued by the Institute of Export, Royal Empire Society Building, Northumberland Avenue, London, W.C.2. Readers are reminded that the Institute is an entirely professional and non-political body, and that education forms the basis of its activities. The brochure affords a clear outline of the services offered by the Institute, and includes a foreword by the Secretary of the Department of Overseas Trade, Mr. Harcourt Johnstone.

Foreign News

A new edition of their Classified Directory has been brought out by the Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st Street, New York.

A new oestrogen, ethinyl oestradiol, 5 to 20 times as potent as stilboestrol, is being marketed by the Schering Corporation of America under the name "Estinyl."

The U.S. Medical Corps is reported to be using bottles made of polystyrene. They are practically unbreakable and 75 per cent. lighter than glass bottles of the same size.

An increase from 35,000 to 39,000 tons in the amount of potash available for use in fertilisers this year has been announced by the Canadian Agriculture Department.

Canada will export 150,000 tons of ammonium nitrate to the U.S.A. this year. The caking problem has been overcome by concentration to about 98 per cent. and subsequent granulation in a shot tower.

A new factory for the production of wolfram and other tungsten products is to be erected by Joaquin G. Solé at Barcelona, according to the Spanish chemical journal, *Ion*.

Cetyl trimethyl ammonium bromide, a cationic detergent with the formula $C_{18}H_{39}(CH_3)_3NBr$, is being sold in America under the trade name "Cetavlon." It is finding extensive use in hospitals because of its antiseptic properties.

Penicillin is being produced in Peru, through the efforts of an advanced student of the Instituto Nacional de Higiene. It is considered likely that this institution, which is responsible for making serums and vaccines, may take over the large-scale production of the drug.

A record output of fluorspar from United States mines is reported for 1943 by the Bureau of Mines, with a total of 408,000 short tons (estimated). Of this, approximately 60 per cent. was of metallurgical grade, 35 per cent. acid grade and 5 per cent. ceramic grade.

A state factory for the manufacture of lime and caustic soda is to be attached to the Bulgarian salt mines, according to *Donauzeitung*. The first factory will not be large and will produce no more than from 4000 to 6000 tons of lime and from 2500 to 3000 tons of soda yearly, about half the country's requirements.

The properties of cetylpyridinium chloride are described in an article in the *American Journal of Pharmacy* (Feb., 1944, p. 50). An antiseptic of high germicidal and bacteriostatic potency, it has hydrophilic properties due to the chloride anion, and lipophilic properties originating from the cetylpyridinium cation which is attracted to lipoids.

The first synthetic butanol plant in Canada came into production recently, states *Chemical Industries*. It is operating at about 30 per cent. above the rated annual capacity of 3,000,000 lb. of butanol. Situated in Quebec, it was financed by the Department of Munitions and Supply, but is operated under contract by private interests.

The new synthetic insecticide, DDT (*THE CHEMICAL AGE*, April 8, p. 342), is to be made in America in much larger quantities. Production at the Cincinnati chemical plant is to be augmented by the output of a \$500,000 factory being built by Du Pont. The raw materials are chloral hydrate and monochlorobenzene. *THE CHEMICAL AGE* understands that this insecticide is not yet being made in Britain.

The chemistry of musk is reviewed in the *American Perfumer* (1943, 45, 12, p. 35). Ether extraction of this valuable perfume-fixative, followed by saponification, results in the separation of a neutral musk oil. 3 oz. of this oil yields 1 oz. of a fraction distilling at 130-170°/1 mm. and solidifying to give a waxy substance with a fine musk odour. By further vacuum fractionation, this substance is shown to be a mixture of 58 per cent. dihydrocivetol (cycloheptadecanol, a cyclic alcohol with 17 carbon atoms), 10 per cent. neo-muscol (cyclopentadecanol) and 2 per cent. of the corresponding ketones.

A new resin distillation plant has been opened at Cazorla (Jaen), Spain, with a yearly capacity of 1500 tons. It is under the control of La Unión Resinera Española S.A., which has a monopoly in this branch of industry.

A British technical unit operating for the Ministry of Supply in the forests of Western Abyssinia is reported to have extracted the first of 10,000 available tons of rubber from wild vines. The rubber is of first grade, but is not comparable in quantity with plantation rubber and is being exploited uneconomically in view of urgent war needs.

The technique of using a high-speed camera to photograph an explosion was mentioned in a note published recently in *THE CHEMICAL AGE* (1944, 50, pp. 201-2). Readers will be interested in a full account of this technique, by R. W. Cairns, of the Hercules Powder Company, Wilmington, in *Ind. Eng. Chem.*, Jan., 1944, p. 79.

Output of the Canadian tar distillers in 1943 was valued at \$6,805,791, an increase of 32.2 per cent. over the preceding year's production. Raw material costs were \$3,833,826; of this sum, \$3,043,221 covered the cost of 37,542,547 gallons of crude tar, and \$254,419 was spent on heating and power. Production was covered by ten distilleries, four of them in Ontario; Quebec and Manitoba have two plants each, and British Columbia and Nova Scotia one each.

Appeals by two Canadian firms of the Niagara District—the Electro-Metallurgical Co., of Welland, Ont., and Welland Chemical Co., of Port Robinson, Ont.—have led the National War Labour Board to decide in favour of the principle of equal pay for equal work for both men and women. One company maintained that women employees needed more supervision, and in a chemical plant the output of individual workers was hard to measure.

The Portuguese Government is reported to have agreed to a replanning of the country's paper industry. A large cellulose plant, based on the sulphate process, using Portugal's extensive forests as raw material, is to be erected by the Companhia Portuguesa de Celulosa, whose initial capital is stated to be 16 million escudos. Construction of the new plant and the initial stages of production have been entrusted to a Swiss group, the Carl Thiel Company of Zurich.

Forthcoming Events

The Midland Section of the **Institution of the Rubber Industry** holds its 20th annual meeting on **May 8**, at 7 p.m., at the James Watt Memorial Institute. This will be followed by a film show, when "World of Plenty" and "The Discovery of a New Pigment (Monastral Blue)" will be screened.

The 12th annual meeting of the **Plastics Group** of the Society of Chemical Industry will be held on **May 8**, at 2.30 p.m., at the Waldorf Hotel, Aldwych, W.C.2. It will be followed by a lecture from Mr. H. Langwell on "The Technique of the Scientific Lecture."

The **Workers Educational Association** and the **Association of Scientific Workers** have jointly arranged a film show, dealing with reconstruction and housing, at the Birmingham University, Edmund Street, at 7.15 p.m., on **May 9**. Admission will be free.

The **Chemical Engineering Group** of the Society of Chemical Industry holds its 25th annual meeting at the Waldorf Hotel, Aldwych, W.C.2, on **May 10**, at 12.15 p.m., to be followed by an informal luncheon.

The annual meeting of the **Iron and Steel Institute** takes place on **May 11**, at 10.45 a.m. at 4 Grosvenor Gardens, London, S.W.1. After the business session and the presidential address, Mr. W. Evans will present a paper on "The Heating of Open-Hearth Furnaces with Mixed Coke-Oven and Blast-Furnace Gas," followed by Mr. A. H. Leckie on "The Study of Thermal Performance of Open-Hearth Furnaces." The afternoon session, which starts at 2.30 p.m., will be devoted to the presentation and discussion of seven papers dealing, in turn, with liquid steel temperatures, photoelectric cells and temperature measurement, thermocouple technique, emissivity characteristics of hot metals, shell-steel and running-steel ingots.

At the **Royal Institution**, Albemarle Street, London, W.1, on **May 12**, at 5 p.m., Dr. W. T. Astbury, F.R.S., director of the Textile Physics Research Laboratory Leeds University, will lecture on "Fibres and Fabrics, Old and New—Their Chemical Structure and Physical Properties."

Company News

Net profit of **The British Drug Houses, Ltd.**, for 1943 was £36,423 (£30,091). A dividend of 3 per cent. has already been recorded.

The British Match Corporation announces a final ordinary dividend of 5½ per cent. for the year to April 30, making 8 per cent. (same). Net profit is £350,184 (£336,777).

The United Turkey Red Co., Ltd., announces a net profit for 1943 of £88,725 (£64,707). After deducting a debit balance of £61,288 brought in, and providing for a first preference dividend for 1938, there remains a credit of £15,790.

The United Molasses Co., Ltd., is paying a second interim dividend of 12½ per cent., less tax, on ordinary stock, making 20 per

cent. (same), with a cash distribution of 2½ per cent. (tax free) as last year. No further distribution for 1943 is contemplated.

Synthetic and Industrial Finishes, Ltd., Watford, Herts., have increased their nominal capital beyond the registered capital of £100 by the addition of £4900 in £1 ordinary shares. The new shares have been allotted for cash to Process Oil Products, Ltd.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

E. C. D., LTD., Tonbridge, manufacturers of chemical apparatus, etc. (M., 6/5/44.) April 11, assignment, securing to Midland Bank, Ltd., all moneys due or to become due to the Bank; charged on contract moneys.

Satisfactions

BRITISH BURMAH PETROLEUM CO., LTD., Taunton. (M.S., 6/5/44.) Satisfaction April 17 of debenture stock registered February 25, 1936, to the extent of £20,000.

Company Winding-up Voluntarily

FISON'S FERTILISERS (WESTERN), LTD. (C.W.U.V., 6/5/44.) April 6 (members). S. R. Brimblecombe, liquidator.

New Companies Registered

Nervona, Ltd. (387,089).—Private company. Capital: £2000 in 2000 shares of £1 each. Manufacturing chemists, etc. Directors: J. Thomas; G. B. Weatherburn, H. Humphreys. Registered office: 295 Scotswood Road, Newcastle-on-Tyne.

Orchard Fertilisers, Ltd. (387,004).—Private company. Capital: £100 in 100 shares of £1 each. Manufacturers of and dealers in fertilisers and horticultural sundries, etc. Subscribers: P. Dalton, 3 Eagle Lane, London, E.11; G. Hawkins.

North Eastern Chemicals, Ltd. (387,041).—Private company. Capital: £5000 in 5000 shares of £1 each. Manufacturers of and dealers in chemicals, colours, by-products, etc. Subscribers: S. Boyd (first director); N. Lowdon. Registered office: 37 Villiers Street, Sunderland.

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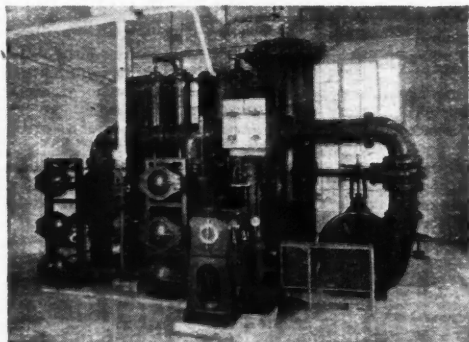
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Boyd, Lockman, Ltd. (387,019).—Private company. Capital: £5000 in 5000 shares of £1 each. Manufacturers of and dealers in chemicals, colours, by-products, etc. Subscribers: S. Boyd (first director); N. Lowdon. Registered office: 37 Villiers Street, Sunderland.

R. P. Finishers, Ltd. (387,187).—Private company. Capital: £1000 in £1 shares. Treathers of metals and other materials to protect against atmospheric or other deleterious conditions, etc. Directors: Ellen Lawson; F. C. Lawson. Registered office: Coventry House, 3 South Place, London, E.C.2.

Alpha Oil Products, Ltd. (387,122).—Private company. Capital: £100 in 100 shares of £1 each. Importers of and dealers in oil, petroleum and paraffin, manufacturing chemists, waste oil dealers, etc. Directors: H. L. Pyper, 30 High Street, Kempston, Beds.; T. E. Harvey; D. S. Judge; D. D. Pyper.

Milner's Chemical Co., Ltd. (387,003).—Private company. Capital: £200 in 200 shares of £1 each. To acquire the business of a wholesale and manufacturing chemist carried on by Emeric A. Eccles as "Milner's Chemical Co." at 198 Union Road, Oswaldtwistle. Directors: A. Taylor; Annie Eccles. Registered Office: 1 Spring Street, Oswaldtwistle, Lancs.

Chemical and Allied Stocks and Shares

AN upward trend of values and a broadening of business in stock markets has followed the promised post-war concessions in respect of obsolescence and of expenditure on new plant and research work. The impression has increased that the authorities are planning to give industry every reasonable assistance to meet the eventual return to peace-time working, and stock markets have reflected this increased confidence in regard to the future. It is realised, however, that during the next few months the trend of markets must be expected to be influenced in a good measure by the progress of the war; but, meanwhile, leading industrials have participated strongly in the upward movement (which has embraced railway stocks, and also rubber shares), particularly shares of companies that normally expend large sums on research or are engaged in developing new industries, as well as those which will have to make large-scale plant adjustments to meet the eventual return to peace-time working.

Compared with a week ago, Imperial Chemical have moved up from 38s. 4½d. to 39s., British Celanese from 26s. 6d. to 28s. 7½d., Dunlop Rubber from 41s. 3d. to 43s., and Wall Paper Manufacturers de-

ferred from 38s. 9d. to 41s. 6d. Iron and Steel issues were particularly favoured, with Guest Keen 38s. 1½d., compared with 37s. a week ago, United Steel 25s. 10½d. compared with 25s., Staveley 52s. compared with 50s., and Colvilles 25s. compared with 23s. Dorman Long were better at 27s. 3d., as were Tube Investments at 96s. 9d., Hatfields at 31s. 3d., Babcock & Wilcox at 50s. 9d., and Whitehead Iron at 82s. Pressed Steel 5s. ordinary were higher at 31s. 10½d. awaiting the dividend announcement. Elsewhere, Murex improved to 105s. 7½d., while British Oxygen have been firm at 80s., as have British Aluminium at 47s. 6d. In plastics, De La Rue moved higher to 176s. 3d., and British Industrial 2s. shares were 6s. 9d. The units of the Distillers Co. moved higher at 91s. 3d., and United Molasses have been firm at 33s. 7½d. on the maintenance of the dividend and bonus payments. In textiles, apart from the rise in British Celanese, Courtaulds were better at 53s. 3d. Bradford Dyers were firm at 20s. 9d., as were Calico Printers at 15s. 3d., while Bleachers were better at 10s. 6d. An improvement to 63s. 6d. was shown in Associated Cement; British Plaster Board were 31s. 4½d.

Nairn & Greenwich held their rise to 74s. 4½d., and Barry & Staines were again higher at 47s. General Refractories showed a better trend at 15s. 9d., as did Imperial Smelting at 14s. 3d., and Amalgamated Metal at 18s. B. Laporte showed dealings ranging up to 80s. Greff-chemicals 5s. ordinary were again 7s. 3d., Monsanto Chemicals 5½ per cent. preference 23s., and elsewhere, Borax Consolidated deferred have been firmer at 35s. 7½d. Cellon 5s. ordinary were 23s., pending the dividend statement, while Pinchin Johnson were firm at 35s., prior to publication of the financial results. Lever & Unilever were unchanged at 35s. 6d. In other directions, Gas Light & Coke ordinary moved higher at 20s. 6d. in the belief that post-war tax concessions in respect of new plant and equipment, etc., will be of considerable benefit to the company.

Boots Drug 5s. ordinary have been firm

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at 43s. 3d., while Sangers were higher at 27s., and Timothy Whites well maintained at 33s. 4½d. Low Temperature Carbonisation 2s. ordinary were maintained around 2s. 4½d. W. J. Bush remained firmly held and quoted at 60s. British Drug Houses ordinary were 22s. 6d. x.d., and Burt Boulton 23s. x.d., while William Blythe 3s. ordinary were 9s. Oil shares reflected the better market tendency, and "Shell" were 77s. 6d. compared with 76s. 1½d. a week ago.

British Chemical Prices

Market Reports

ACTIVITY appears to have been sustained in most sections of the London chemical market during the past week and a firm tone is reported. Trading conditions are following a steady course and a moderate volume of new inquiry has been in circulation. Deliveries to the main consuming industries, chiefly against contracts, have been steadily maintained. The soda products generally are an active market, with chlorate of soda in short supply, while a good demand is in evidence for caustic soda and bicarbonate of soda. Quotations for yellow prussiate of soda are very firm. In the potash section there is a steady movement into consumption for priority uses. Permanganate of potash is firm and in good request, while supplies of both

caustic potash and bichromate of potash are none too plentiful. In other directions there has been a steady inquiry for acetone, formaldehyde, and white powdered arsenic, while oxalic, tartaric, and citric acids continue to be on the short side. Producers' quotations for borax and boric acid were advanced from April 24—borax by £2 10s. per ton and boric acid by £9 5s. per ton. Conditions in the coal-tar products market remain steady with a ready market for available supplies. Cresylic acid is in good demand and a moderate business has been transacted in the pyridines and xylols. Solvent and heavy naphthas continue firm.

MANCHESTER.—If new business in heavy chemical products on the Manchester market during the past week has, on the whole, been only moderate, sellers have little ground for complaint regarding the rate at which existing orders for all classes of materials are being taken up. Market values are on a continued firm basis throughout, but there has been no change of any consequence to report since last week. With regard to the tar products, delivery specifications are flowing in steadily for nearly all classes of light materials, and also for most of the heavies.

GLASGOW.—In the Scottish heavy chemical trade the position remains unchanged from last week, home business continuing steady. Export trade is rather restricted. Prices keep very firm.

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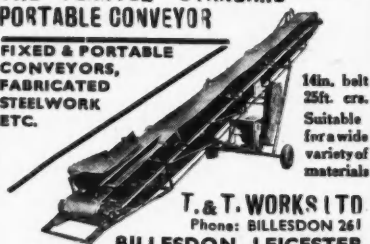
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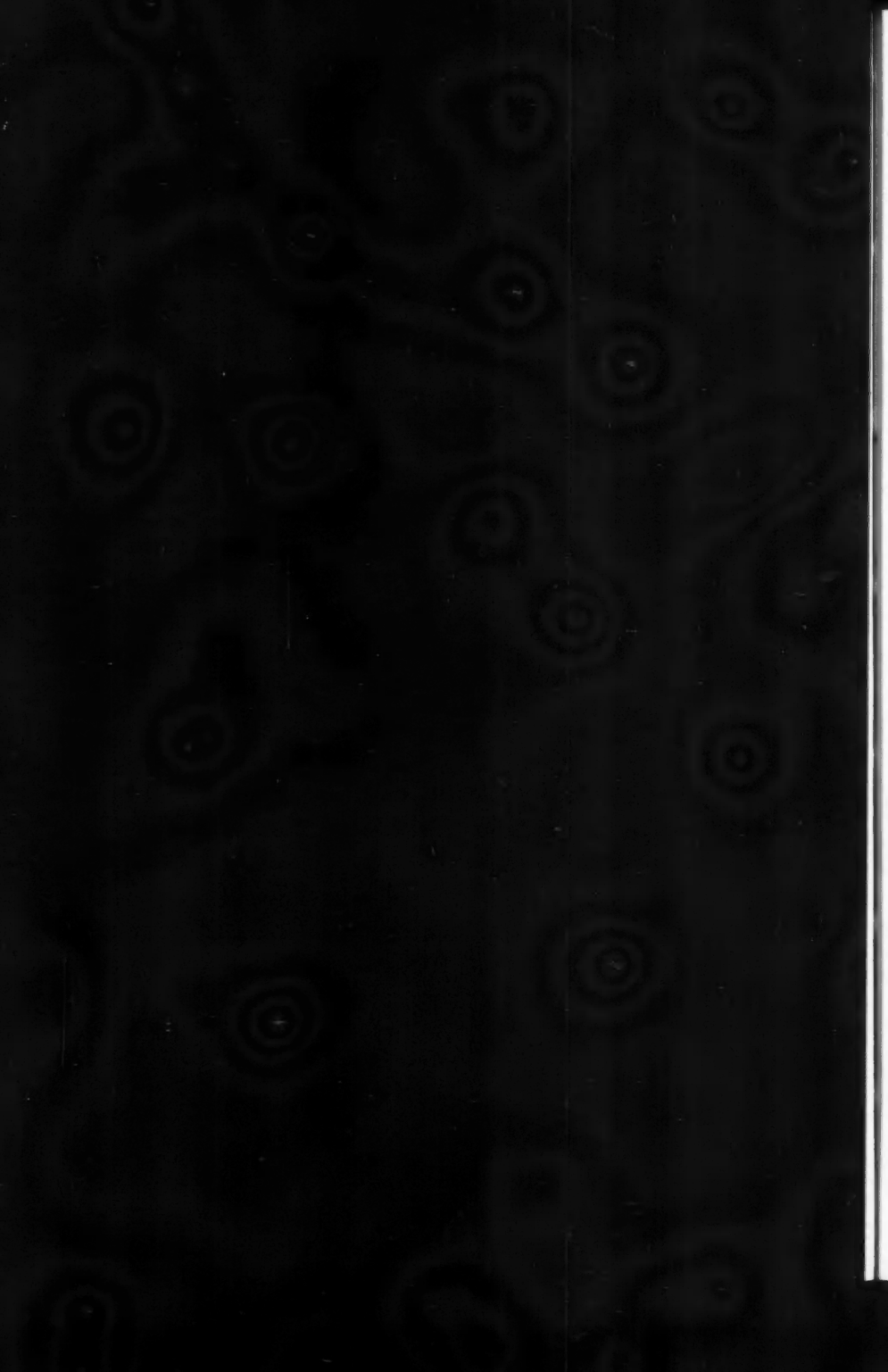
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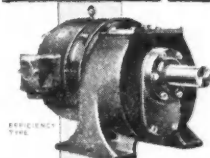
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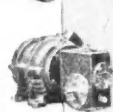
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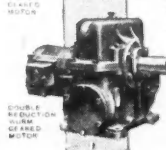
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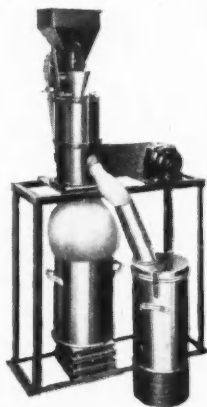
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